THE

ELECTRICAL REVIEW.

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"ELECTRICAL REVIEW."

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THE

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1902 Edition

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ELECTRIC TRACTION ON RAILWAYS.

WE have frequently in the past had occasion to discuss the important question of the conversion of our railways from steam to electric traction, and the position which we have always taken up is that there is a very wide field for electric traction in railway work, and one which is probably larger in England than in any other country in the world. This consists in the application of electric traction to our suburban lines around our big towns, and in crowded districts, such as exist in the North of England.

The conditions that obtain in this country are quite different from those which are met with on the other side of the Atlantic. In America there is practically no speed limit imposed, nor any equivalent of our Board of Trade to regulate the methods to be adopted, and, as a consequence, the tramways have, to a large extent, practically absorbed all the suburban passengers, leaving the railway companies nothing but long-distance passenger traffic. In this country matters are different, and the railway companies by electrifying their lines, will be able not only to hold their suburban traffic, but to greatly increase it. We think that if our railways are electrified, and sufficient terminal facilities are available, passengers will always travel distances exceeding four or five miles by a railway in preference to a tramway. It is a well-known fact that many railways consider their suburban traffic a nuisance, and would like to do away with it entirely, as it is not so remunerative as their long-distance traffic, and, in many instances, so encumbers their stations and approaches as to cause serious delays to their main line trains. In such cases it might be argued that it would be to the advantage of the railway company to give up the suburban service entirely, and only continue the main-line trains. Unfortunately, the capital invested in the lines, stations, &c., which are only used or required for suburban traffic, is so great that no company can afford to write it off. This being the case, they must turn to electrification as the only remedy, as otherwise the traffic will be greatly diminished, owing to the network of tubes and tramways which are now under construction, authorised, or being promoted.

Since the time of the now famous arbitration between the Metropolitan District and the Metropolitan Railways, and notwithstanding the fact that authorities like Major Cardew and Sir William Preece so strongly favoured the adoption of a polyphase system, we have always maintained that the direct current series-wound motor is the only one that can be seriously considered for the work which is required on our suburban lines, and that, owing to the enormous traffic and frequent service, there is no difficulty in economically installing it.

We now return to the subject in consequence of the proposed application of alternating currents for electric traction purposes in America, as set forth in the paper read by Mr.

Lamme before the September meeting of the American Institution of Electrical Engineers, of which an abstract was published in our issues of October 24th and 31st.

The experiment is being carried out by the Westinghouse Co. on about 45 miles of track, and will be watched with great interest by all engineers; but even should it be successful, it will not necessarily show that the alternating system is the correct one for our suburban railways, as the line being equipped in America is practically a long-distance line.

It may be that a single-phase alternating-current motor will some day be designed to satisfactorily fulfil all the conditions required by railway work, but we are disposed to agree with Mr. Steinmetz in the remarks which he made in the discussion which followed Mr. Lamme's paper, to the effect that alternating-current traction will only come into practical use when a single-phase motor is made to start with a maximum torque, the torque decreasing with increase of speed.

We will not here discuss the details of Mr. Lamme's suggestions; suffice it to say, that of all the alternating current systems suggested up to the present this certainly is the most promising, being the most simple.

As frequently stated, we do not wish to be thought adverse to the adoption of electric traction on main line railways, or to bar the path of progress. We would impress upon railway companies, as we have done so often, the necessity of taking immediate steps to electrically equip their suburban lines, which they will have to do unless they are prepared to entirely give up the suburban traffic and write off all the capital invested in the lines and stations which have been built for this purpose only.

While we are perfectly prepared to give all credit to Messrs. Mordey and Jenkin for having so carefully considered the use of alternating current motors in connection with traction work, at the same time we hold that papers of the description read by them do more harm than good. We think that such suggestions in connection with operating main-line railways electrically, coming from such a quarter, are to be discouraged, as they only tend to cause one of two great evils—either to encourage unprincipled promoters, and to give weight to their plausible arguments in favour of long-distance lines, and thus enable them to obtain money from the ignorant public for schemes which are hardly likely to be successful; or else to furnish excuses to the chairmen and fossilised directors of railway companies, for putting off the day of electrification, and enable them to persuade their shareholders that electricity is so much in its infancy that they dare not adopt it.

Mr. Carnegie on Industrial and Intellectual Supremacy.

Mr. Andrew Carnegie, LL.D., has taken the opportunity afforded him by his recent installation as Rector of St. Andrews University to give us his opinion as to the result of the present struggle for the industrial supremacy of the world. For two chief reasons the land of his adoption must eventually become supreme in industry; in comparison with the United Kingdom, or indeed, with the whole of Europe excepting Russia, the United States *is* (Mr. Carnegie would clearly prefer the singular verb) so vast in extent and so free from wars and rumours of wars. Inasmuch as home commerce is the "true king" or basis of industrial ascendency, while foreign commerce is but "a braggart always in evidence," the United States must come ever more to the front, for it is still relatively undeveloped and sparsely populated, whereas Europe (again excepting Russia), and particularly Great Britain, have already been more completely opened up and even suffer from a surplus of population. There is no doubt much truth in this; more truth than is pleasing to a European's pride. And yet the subjects of King Edward VII. have colonies and dependencies almost unexplored and wholly devoid of civilised population; maybe these territories contain coal, iron ore, &c., which will outlast the deposits of the States; maybe they will one day provide us with food, and leave us no longer at the mercy of "American" and Argentine cattle breeders, of Russian growers of wheat. Inevitably the States must retain the great advantage of its isolated geographical position, for it has practically no frontiers to guard day and night with a costly army, and no narrow seas to patrol with an equally expensive fleet. Mr. Carnegie boldly gives us the alternatives; universal disarmament, or the position of satellites to the American sun. Perhaps these are not true alternatives—there may be a third course for us of Europe—but if the States does actually become the hub of the universe, it will acquire that position by right of size and activity, for it is even now a "combine" of 45 States, some larger of themselves than the whole United Kingdom.

Having thus relegated us to a subordinate place in material affairs, Mr. Carnegie offers the land of his birth, in conjunction, we hope, with its "predominant partner," the position of intellectual supremacy. The States is to produce the Rockefellers, the Carnegies, the Pierpont Morgans; we are to breed the Shakespeares, the Gibbons, the Faradays. It is, as the Rector of St. Andrews says, a higher, nobler function; but it is one which will not appeal to the denizens of Lombard Street, for our acceptance of the duty might seriously affect our income-tax returns. As intellectual supremacy must depend to a very large extent upon pre-eminence in education, Mr. Carnegie wishes to see the facilities for education in this country cheapened and widened; and not contenting himself with pious aspirations, he has contributed of his substance, munificently, if not always quite judiciously, to the aims he has at heart. The shape his benefactions have taken in England is mainly that of providing the capital necessary for the establishment of free libraries, the proffered gift being dependent upon the willingness of the ratepayers in the locality selected to tax themselves permanently to the maximum extent permitted by the Public Libraries Act. A public library is perhaps not the very best educational establishment which can be erected for a given large sum of money; but it is always of enormous value to the district. The librarians will state, and the visitor's eye will show, that the good technical journals and the best books of reference are not neglected for the sake of vapid illustrated magazines and ephemeral novels in such reading rooms; but were the latter the only material provided or utilised, free libraries, open till late in the evening, are one of the best methods yet discovered for combating, among the working classes, whose "homes" are dreary and uncomfortable, the attractions of that terrible curse of modern life—the saloon bar of the gorgeous gin-palace.

Electrical Engineers and Boiler Efficiency.

No man is more concerned than the electrical engineer in the economical use of fuel, which represents, as a rule, over 50 per cent. of the actual generating costs. One would naturally suppose, therefore, that the use of this coal in the boilers of electricity supply works would be carried out under the conditions which yield a maximum efficiency, and that all modern boiler plants would be designed and worked on

scientific principles; but those who have visited many electric lighting stations will know that the scientific management of boiler plants is not specially characteristic of the modern electrical engineer. As long as sufficient steam is raised to keep the machinery running, and smoke prosecutions are avoided, the electrical engineer is satisfied.

If steam fails, or smoke prosecutions have to be met, the blame is always laid on the fuel; and the usual plan is to fall back upon South Wales anthracite until the troublesome days are past.

Mr. Booth showed, in his B.A. paper, that cheaper fuels than anthracite can be burned without smoke, with due regard to economy in steam raising, even in water-tube boilers, when these are properly designed. It is obvious that fuels containing 30 to 35 per cent. of volatile hydrocarbons, will demand other conditions for complete combustion than fuels containing only 10 per cent. of volatile products. Yet engineers and boiler makers have been ignoring this fact for years, and have been building and erecting boilers without the slightest regard to the type of fuel which they will be required to consume. The result is, that when bituminous fuels are burned in these boilers, either smoke results, or the smoke is avoided by the use of excessive draught.

The connection between waste of fuel and excessive draught has not been sufficiently recognised. The waste gases passing from the boilers carry a large proportion of the heat of the fuel away with them, and complete combustion in the furnace, without undue access of air, can only be realised with certainty when the waste flue-gases are regularly tested to ascertain the percentage of carbon dioxide contained in them. Good work demands 14 per cent. of CO_2; 8 per cent. of this gas represents 2·36 times the requisite amount of air, and a loss of heat equivalent to 10 per cent. of the fuel used. Even when economisers are used, the loss with chimney gases containing only 8 per cent. of CO_2, may amount to 5 per cent. of the coal burned in the furnaces of the boilers.

These figures show that boiler plants deserve more attention from electrical engineers than they have been in the habit of giving to this department of their works. The engineer of one of the finest generating plants in the country recently stated that he would be satisfied if his boilers were evaporating 8 lbs. of water per lb. of fuel, or 75 per cent. of the maximum attainable under the best conditions. Such *satisfaction* with results 25 per cent. below the best possible, is, we are afraid, much too common at the present time amongst British electrical engineers.

More about Education.

The presidential address delivered by Mr. J. Tweedy to the North-East Coast Institution of Engineers and Shipbuilders on October 24th last, was naturally taken up for the most part with a discussion of subjects in which we are not specially interested; but in one portion of his paper, the author made some useful remarks upon the subject of education. Mr. Tweedy points out that a good workman may be inferior as a man to a bad workman, for to live sensibly and rationally is a more abstract and difficult matter than to turn a shaft or plate a ship. Therefore, although proper technical education is necessary, a good general education is far more necessary, since everybody must read, and ought to have the power of enjoying good books, while only some of us need to study engineering. There is an education question in Germany, similar and opposite to that which is agitated here. The fault of the Englishman is to neglect theory for practice; the fault of the German is to despise everything but theory. A Prussian State engineer at 30 years of age may have only just passed his final examination. "The practical solution of most of the technical problems of life must, in the future as in the past, be the work, not of pure mathematicians or other theorists, but of scientifically-trained, practical men; and the technical instruction of such men, to be really effective, must be conducted by scientific practical men, who have, in addition, specialised for teaching."

THE PURIFICATION OF THE ATMOSPHERE BY OZONE.

By ERNEST T. WILLIAMS.

It has long been known that ozone has valuable purifying properties, but up to the present little seems to have been done to make use of this knowledge, and to manufacture ozone on a commercial scale. Now, however, this matter is being taken up through the patents of Mr. J. Harris, and a description of the apparatus may be of interest. Ozone is an allotropic form of oxygen; it is denser, has more active chemical properties, is slightly soluble in water, and has a characteristic smell.

Ozone may be generated by passing electric sparks through oxygen; this knowledge is not new, for as early as 1785 it was known that the passage of electric sparks through

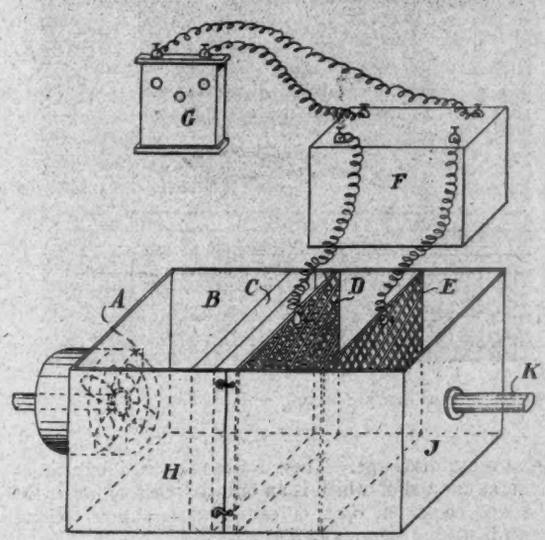


Fig. 1.

air was accompanied by a peculiar smell, and in comparing lightning and electricity, Franklin noticed that both when discharged gave what he termed a "sulphurous smell." In 1840 Schönbein noticed this characteristic smell was the same as that given by electrolytic oxygen.

Now we are aware that existing in the atmosphere with other impurities there is volatile organic matter which is detrimental to health. One becomes aware of such organic putrescent substances when entering a crowded room from the fresh air.

The presence of ozone means instant death to these substances, and to the insidious microbe of which medical science has of late learned so much. What is known as the

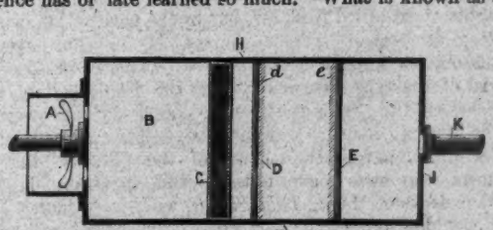


Fig. 2.

clearing of the air after a thunderstorm is due to the ozone that has been formed through the lightning discharges. It is well known in the country that the plague of blight or fly which attacks the crops, is cured by a violent thunderstorm.

One can understand then that for purifying the vitiated atmosphere of crowded rooms and buildings, and for the sterilization of water, &c., ozone produced on a commercial scale is invaluable. Fig. 1 is an illustration of apparatus designed for this purpose, and fig. 3 is a photograph of the actual exhibit in Manchester by the Atmospheric Electrical

Purification Co., Ltd., at their offices; this is capable of dealing with a volume of 60,000 cub. ft. in ten minutes, *i.e.*, it will purify the vitiated atmosphere of a room of that capacity in the time stated. Fig. 2 is a diagrammatic sketch of the apparatus. Current is taken from any available source and passed into a small motor-generator or Ruhmkorff's coil, G; from this it is taken as a high voltage high frequency current to a special transformer of the "Tesla" type F, where it is transformed to a very high pressure. From here it passes to the metal screens D and E, sparking across from one to the other at a thousand points

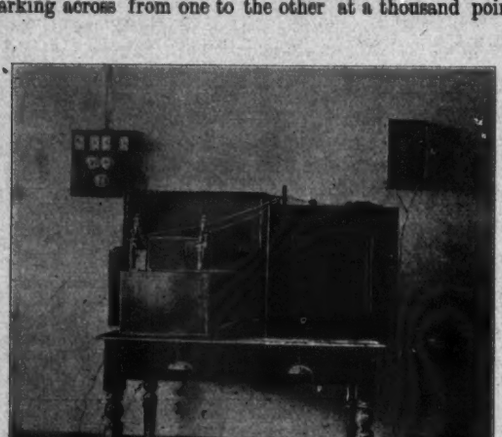


Fig. 3.

with a brush discharge. These screens are fixed in a closed box H, at one end of which is an ordinary electric fan A, the other end being left open, or closed when a pipe conduit system is used as shown at J and K.

The action is as follows:—Current is switched on to the transforming apparatus and an electric discharge continues to pass between the two metal screens. The fan is then switched on, and this draws in the air and discharges it into the conduit K, or the open atmosphere; in passing, the air comes into contact with the electric discharge between the screens, where ozone is formed which immediately kills any organic matter that may be present, and pure air mixed with ozone passes along the conduit to the point for ventilation.

During a recent test of the apparatus at which the writer was present, immediately the current was switched on the presence of ozone was apparent from its invigorating smell.

It is beyond the purpose of this article to describe the numerous applications for commercial ozone, but its chief field will be for ventilation—ventilation not by strong draughts of so-called fresh air, but by the purification of the existing atmosphere. The company is only of recent formation, but already it has received evidences of success. A trial of the apparatus was made in the dining hall of the Manchester, Ltd., restaurant, on the occasion of the meeting of the Medical Congress; and in the writer's possession are copies of letters from the officials of the "Beaver" line of steamers, who have made tests of the apparatus on the steerage decks of the ss. *Lake Simcoe*, with every success.

It would be impossible as yet to say if this system will meet all the requirements of efficient ventilation, but some good will be done if it only goes some little way in helping to solve that much misunderstood problem.

The members of the profession will be glad to see that electricity is again finding a field for usefulness, and will await further developments with interest.

Chester.—On 30th ult. a L.G.B. inquiry was held re the T.C.'s application for a £5,924 loan for purposes connected with the supply of energy for tramways.

ELECTRIC RAILWAYS IN GERMANY.

The Reduction of Vibration and Noise. Storage Battery Cars for Local Steam Lines.

The overhead electric railway in Berlin, the first section of which was opened to traffic several months ago, has formed the subject of many complaints on the part of the public, in consequence of the noise made by the running of the trains, and the operating company has therefore been induced to undertake a series of experiments with the object of minimising the evil arising from this cause. So far, however, as they have proceeded, the experiments have not led to a definite conclusion on the matter, but at the request of the police authorities, who have been largely instrumental in endeavouring to secure an abatement of the nuisance, a preliminary report has been issued, dealing with the measures which have already been taken in this direction. It appears, in the first place, that layers of felt were placed between the rails and the sleepers for a length of 1,000 metres, but this step has not fulfilled expectations, as the sound-deadening effect thereby produced was only very slight. Secondly, in place of the wooden transverse sleepers, iron girders, filled with sand, and closed by a cover, were laid down on another part of the railway. It was hoped that the hollow space filled with sand would take up the vibration and shocks, and thus suppress the noise. Tests made in this manner on a small scale away from the railway, had previously yielded tolerably satisfactory results, but a definite opinion on the subject of the present efforts which are being made on a large scale cannot yet be formed. In the third place, trials are being made of longitudinal wooden sleepers, instead of cross sleepers; fourthly, tests are being carried out in the direction of surrounding the base of the rail with lead; and fifthly, by arranging lead plates between the rails and the sleepers. The final experiment consists in lining the car wheels with wood. It is proposed to conduct tests with other measures which are thought likely to yield good results, but the suggested remedies will naturally require a long time before any reliable opinion can be formed as to which is the best suited to the requirements of the case.

In the meantime it is noteworthy that negotiations are being continued for the purpose of extending the overhead electric railway in question into the interior of the city. As bearing on this point, it should be mentioned that difficulties arose a short time ago between the Siemens & Halske Co.—which works the overhead line—and the municipal authorities in regard to the proposed underground railway Potsdamer Platz—Gendarmen—Spittelmarkt—Alexander Platz. The differences related to the question of arriving at an agreement as to the manner in which the elevated extension, apparently dipping as an underground line in this particular locality, should cross at the Gendarmen Markt, the projected municipal electric railway from the north to the south of the capital. The company has therefore prepared a fresh plan, which renders it possible for the stations of both railways in the vicinity of the Gendarmen Markt to be arranged as shallow stations, and not as deep level lines, one tunnel to pass over the other. As this proposal has now received the approval of the municipal authorities, the company has endeavoured to meet the further wishes which have been expressed, by modifying the scheme for the proposed branch line of the overhead railway, which will now pass from the Spittelmarkt *viâ* the Molkenmarkt to the Alexander Platz. It is expected that this route, which has been suggested so as to more adequately cope with the transport requirements, will also be sanctioned. The municipal scheme for the construction of an underground electric railway provides for the building of a line from the north of Berlin at the See Strasse to the south-west of the city at Schoneberg. A project for this purpose has been elaborated by the Berlin Underground Railway Construction Co., which estimates that the expenditure would amount to £2,800,000. This sum compares unfavourably with the cost of the overhead electric railway which amounted to £1,600,000, although the mileage in each case is practically the same.

A remarkable step is proposed to be taken by the Saxon State Railway Administration for the purpose of handling

passenger traffic on local lines during the intervals when the steam trains are not running, and on secondary railways where there is little traffic at any time of the day or evening. It was at first reported to be the intention of the railway authorities to place in service three full gauge motor cars for running on the ordinary rails—one to be a secondary battery car, the second a Daimler motor car, and the third a Serpollet steam car. This report, which was circulated at the beginning of August, has now been amplified by a Dresden correspondent, who, however, states that accumulator cars only are to be experimentally introduced, the innovation being due to the enterprise of the new Saxon Minister of Finance and Railways. It is said that orders for the construction of the requisite number of cars have been given to two works by the General Railway Administration, each coach to be capable of accommodating 60 persons. The first sections of the Saxon railways to be worked by the storage battery cars for local traffic are those from Klotsche to Konigsbruck, and from Dresden to Tharandt, where the interval between the running of steam trains sometimes amounts to as much as five hours. The originators of the scheme, which has been discussed for a considerable time past, assume that the financial results will be satisfactory, although it is not intended to extend the application of accumulator cars to other parts of the Saxon railway system until it has been shown how the forthcoming experiment proves to be in everyday working.

The Continental Co. for Electrical Enterprises, of Nuremberg—the Schuckert financial trust and the constructor of the Elberfeld—Barmen suspended electric railway on the Eugen Langen system—has elaborated a scheme for the establishment of a similar railway in Berlin, and details of the proposal have been submitted to the responsible authorities. As is tolerably well known, the existing city railway proceeds from east to west, but the projected suspended railway for express traffic and the transport of the masses is intended to be built so as to form a connection between the north and the south. It should, however, not be confounded with the underground electric railway proposed by the municipal authorities as above mentioned, and which is to commence in the neighbourhood of Wedding Platz and terminate at Schoneberg, the route being from the north to the south-west of the city. The suspended railway is, in fact, to begin at the Gesundbrunnen, and have as its terminus the vicinity of the circle railway station in Hermann Strasse, Rixdorf. It is estimated that the cost of constructing the railway would amount to about £80,650 per mile, but as all proposals for overhead lines meet with opposition in Berlin, the realisation of the present scheme is a matter for the future to determine. The project has already been objected to by a public meeting held in the north of Berlin a few days ago, and a petition against it is to be lodged with the authorities.

The experiments in the direction of high speed railway working, which were temporarily discontinued some time ago, have now been resumed on the military railway between Berlin and Zossen by the investigation company for express electric railways, and will be continued until the arrival of winter. Two new motor cars have been built for the purpose by the Allgemeine Elektricitäts Gesellschaft and the Siemens & Halske Co. respectively, the car made by the latter being materially lighter than that used in connection with the first experiments made some time ago. The first run took place on October 18th, when visitors entered the A.E.G. car at Marienfelde and travelled in the direction of Zossen. A stop being made, the party alighted and journeyed in the S. and H. car back to Lichtenrade, where a second descent was made in order to allow the visitors to witness the cars pass each other at the high speed of from 74 to 80 miles an hour. In addition to the experimental operation of the two cars for the purpose of completing the measurements made during the initial tests and amplifying the data then obtained, the performances of the cars in hauling one, two or more ordinary railway coaches are also being ascertained. It is not intended to attempt a higher speed than 80 miles an hour until the permanent way has been partly reconstructed, and the Minister for Railways has already consented to the allocation of heavier rails for this purpose.

In conclusion, it may be mentioned that the Grand Berlin Tramway Co. and the Berlin Charlottenburg Tramway Co. expect in a few days to have the last accumulator cars in service removed from the streets, the cars having always proved a source of trouble and dissatisfaction. The former company had been required to substitute the conduit system to meet local conditions in the Friedrich Wilhelm Strasse and on the Grosse Stern, but as considerable difficulties would have arisen in the execution of the work, the Minister of Public Works has granted permission for the introduction of the overhead trolley system. The Minister has also generally approved of a scheme of municipal electric tramways, although some modifications in the plans relating to the proposed routes have to be made at the request of the authorities.

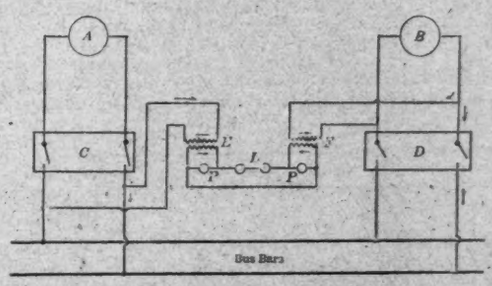
THE OPERATION OF ALTERNATORS IN PARALLEL.*

By FRED. P. WOODBURY.

Two alternators may be run in parallel when their voltages and frequencies are equal, but they must, of course, be in phase or synchronism when the connecting switch is closed. To ascertain the phase relation of machines to be thrown in parallel, synchronising lamps are commonly used.

Fig. 1 shows the connections of two 2,000-volt single-phase alternators with transformers used to reduce the E.M.F. to 100 volts for the synchronising lamps; A and B represent the machines, C and D the main switches, E and F the transformers, L the synchronising lamps, and P, P, pilot lamps. Great care must be taken to get the transformer connections right, otherwise the lamps may burn

Fig. 1.



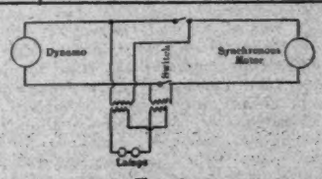


Fig. 2.

brightly when the machines are in phase, and be dark when in opposition, in which case a serious accident would occur if the machines were thrown together. For this reason it is desirable to connect the transformer of one machine, say, A, temporarily to the bus-bar side of the main switch, as shown in the diagram.

Now when both the machines are up to full speed and voltage, if the switch C is closed (D being open) the synchronising lamps ought to begin to flicker, and the pilot lamps to burn steadily, showing that there are no open circuits in the transformer connections or broken filaments in the lamps. Then the switch C is opened, and the switch D closed, when the same potential will be thrown across the primaries of both transformers, and a condition will exist similar to that when the machines are in synchronism. Therefore the synchronising lamps should be dark, while the pilot lamps burn.† If this is not the case, reverse the primary leads of one transformer, and the synchronising lamps will be dark. Now open the switch D, and close C once more; the synchronising lamps will begin to flicker, and the switch D may be closed without accident when the lamps are dark. The lead wires of the transformer, E, should be transferred to the other side of the switch C, great care being taken not to reverse them in the process.

Fig. 2 shows the connections of transformers and synchronising lamps sometimes used for starting synchronous motors or rotary converters. With this method of connection, however, it is necessary to have another switch to entirely open the circuit between the two machines, and the transformers are useless for any other purpose but synchronising.

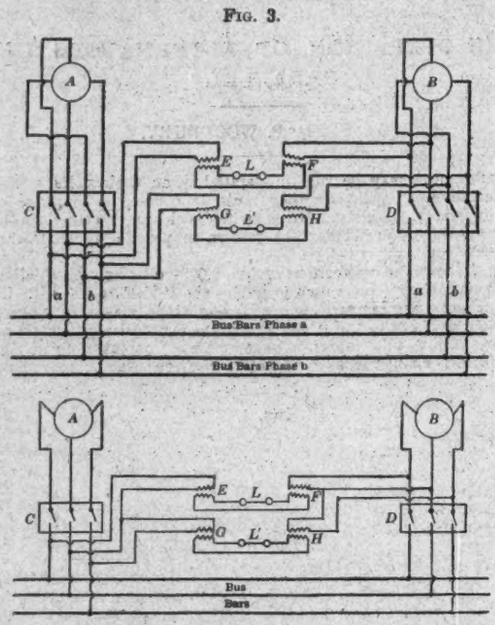
* Abstract from the *American Electrician*.

† This is contrary to the usual practice in this country.—Eds.

In connecting two-phase generators for parallel running, it is necessary to synchronise both phases the first time the machines are paralleled. After they have once been "phased up," synchronising one phase is sufficient. *Fig.* 3 shows the connections for properly "phasing up" two two-phase generators, where A and B represent the generators; C and D, the four-pole main switches; E, F, G, H, the transformers, and L, L', the synchronising lamps. When the machines are running at full speed and voltage, if the switch C be closed the lamps will begin to flicker, showing there are no open circuits in the apparatus. Then the switch C should be opened and D closed, in order to ascertain if all the transformers are connected correctly.

Next cross any primary leads that may be necessary to make all the lamps dark; then open the switch D, and close the switch C, and the lamps L and L' ought to begin to glow in unison, that is, attain maximum brightness at the same instant, and die out together. If, however, one phase is bright when the other is growing dark, the phases are connected wrong, and the lead wires of one

Fig. 3.



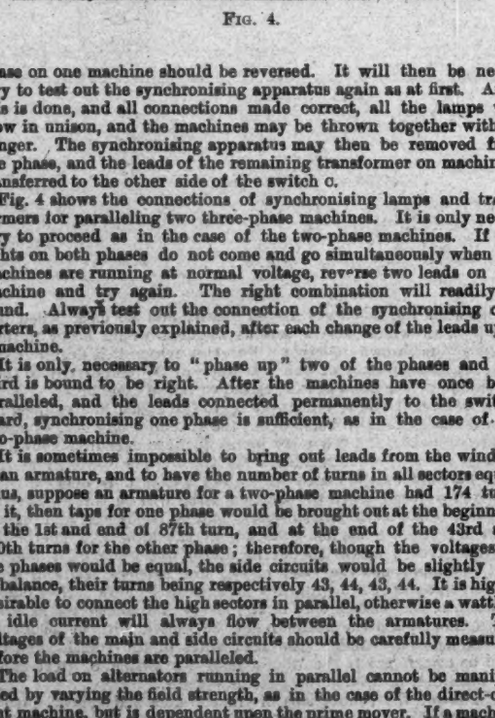


Fig. 4.

phase on one machine should be reversed. It will then be necessary to test out the synchronising apparatus again as at first. After this is done, and all connections made correct, all the lamps will glow in unison, and the machines may be thrown together without danger. The synchronising apparatus may then be removed from one phase, and the leads of the remaining transformer on machine A transferred to the other side of the switch C.

Fig. 4 shows the connections of synchronising lamps and transformers for paralleling two three-phase machines. It is only necessary to proceed as in the case of the two-phase machines. If the lights on both phases do not come and go simultaneously when the machines are running at normal voltage, reverse two leads on one machine and try again. The right combination will readily be found. Always test out the connection of the synchronising converters, as previously explained, after each change of the leads upon a machine.

It is only necessary to "phase up" two of the phases and the third is bound to be right. After the machines have once been paralleled, and the leads connected permanently to the switchboard, synchronising one phase is sufficient, as in the case of the two-phase machine.

It is sometimes impossible to bring out leads from the winding of an armature, and to have the number of turns in all sectors equal. Thus, suppose an armature for a two-phase machine had 174 turns on it, then taps for one phase would be brought out at the beginning of the 1st and end of 87th turn, and at the end of the 43rd and 130th turns for the other phase; therefore, though the voltages of the phases would be equal, the side circuits would be slightly out of balance, their turns being respectively 43, 44, 43, 44. It is highly desirable to connect the high sectors in parallel, otherwise a wattless or idle current will always flow between the armatures. The voltages of the main and side circuits should be carefully measured before the machines are paralleled.

The load on alternators running in parallel cannot be manipulated by varying the field strength, as in the case of the direct-current machine, but is dependent upon the prime mover. If a machine is not taking sufficient load, the power of the engine or water-wheel driving it must be increased, so that the machine will tend to speed up and take load from the other machines in the battery.

The voltage at the terminals of all machines running in parallel must be equal; if the field strength of one of the machines in a battery is greater than that necessary to maintain its voltage under the load it is carrying, if it were running independently, then a lagging current will flow in the armature sufficient to demagnetise the fields enough to produce a terminal voltage equal to that of the other machines in the battery; conversely, if the field excitation is not sufficient to produce a voltage equal to that of the other machines in the battery, then a leading current will flow in the armature, thus raising the field magnetism sufficiently to produce the necessary voltage at the terminals. Therefore, it is desirable to properly adjust the field strengths of machines running in parallel, particularly if they are of large size.

The current of air that is constantly drawn through a machine when running deposits a large quantity of dust in the winding. Often this dust contains a large percentage of carbon, and it also furnishes a medium in which moisture may collect and thus reduce the insulation resistance of the machine very materially. For this reason the armature and field coils should be carefully blown out with a jet of compressed air every 10 or 12 days.

The insulation between the conductors and the iron should be tested every time the machine is cleaned. This test should not be very severe; 50 per cent. above the normal voltage of the machine is ample.

A RECEIVER FOR ELECTRIC OSCILLATIONS.*

By PROF. MINCHIN.

The receiver consists of a small cylinder of carbon whose ends are supported in two loops of aluminium wire.

An aluminium wire, about $\frac{1}{75}$ in. in diameter, *m* A B *n*, fig. 1, is bent into the shape represented in the figure, there being two small loops at *m* and *n* into which the ends of a small carbon rod fit horizontally; the length of the part A B is about 1 centimetre, but it may be smaller at pleasure, and this length indicates the dimensions of the rest. The carbon cylinder, C, has a fine platinum wire, *q*, attached to it, and the aluminium wire A B has a platinum wire, *p*, attached. The system is put inside a small glass tube, G, the lower end of which contains some mercury into which the wire *q* dips, this mercury being also in contact with a platinum wire, Q, sealed into this end of the tube. The wire *p* is sealed into the upper part of the tube and led out of the tube so that it can be used as a terminal P for connection with the enclosed aluminium wire A B. Before the tube is sealed at its upper end the mercury is boiled, so that the tube gets filled with mercury vapour, and in this condition it is sealed.

The contacts of the carbon cylinder with the aluminium loops at *m* and *n* are the places where the electrical resistance of the circuit P *p* C *q* Q is affected by electric oscillations. The apparatus for receiving the waves sent out by a distant oscillator consisted of a

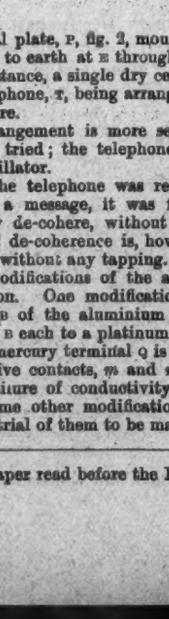


Fig. 1.

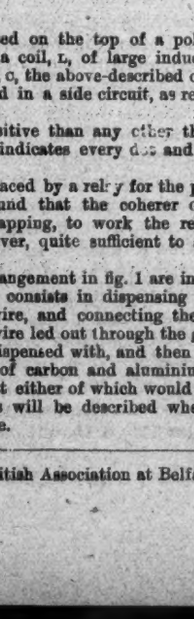


Fig. 2.

large metal plate, P, fig. 2, mounted on the top of a pole. P was connected to earth at E through a coil, L, of large inductance but small resistance, a single dry cell, C, the above-described coherer, G, and a telephone, T, being arranged in a side circuit, as represented in the figure.

The arrangement is more sensitive than any other that I had previously tried; the telephone indicates every dot and dash sent by the oscillator.

When the telephone was replaced by a relay for the purpose of recording a message, it was found that the coherer G did not sufficiently de-cohere, without tapping, to work the relay. The amount of de-coherence is, however, quite sufficient to affect the telephone without any tapping.

Some modifications of the arrangement in fig. 1 are in course of construction. One modification consists in dispensing with the portion A B of the aluminium wire, and connecting the portions *m* A and *n* B each to a platinum wire led out through the glass tube. Thus the mercury terminal Q is dispensed with, and then there are two sensitive contacts, *m* and *n*, of carbon and aluminium in the coherer, failure of conductivity at either of which would affect the relay. Some other modifications will be described when leisure permits a trial of them to be made.

* Paper read before the British Association at Belfast.

LEGAL.

Bray v. the Mayor and Burgesses of Hastings.

In the Chancery Division of the High Court of Justice on Thursday last week, Mr. Justice Buckley concluded the hearing of the case of the Attorney-General and John Bray against the Mayor and Burgesses of Hastings, Mr. Murphy, and the Hastings Tramways Co., which was brought by Mr. Bray, a ratepayer, to obtain a declaration that an agreement of June, 1901, relating to the construction of the tramways, was null and void. An injunction was also sought to restrain the defendants from carrying its provisions into effect. The action was before the Court last May, when it stood over to allow of the addition of the Tramways Co. and Murphy as parties. No witnesses were called. The facts appear from the following judgment:—

His Lordship, in giving judgment, said the plaintiff, John Bray, a ratepayer of the Burgh of Hastings, sought a declaration that a certain agreement of June 1st, 1901, was illegal *ultra vires*, and should be held null and void, and an injunction to restrain the defendants from carrying it into effect. The action came on for trial first as a non-witness action last May, and was discussed at considerable length, but it was impossible to decide the case as the record was then constituted. The agreement of June 1st, 1901, was an agreement made between the Hastings Tramways Co. of the first part, the Corporation of Hastings of the second part, and Murphy of the third part, and the only defendant of the action in May was the Corporation of Hastings. It was impossible to decide that the agreement was *ultra vires* in the absence of the other two parties to the agreement. Accordingly the action stood over for the purpose of adding the defendants, Murphy and the Tramways Co. These defendants had since been added, and the action came in the witness list that the defendants might have an opportunity of calling witnesses if so disposed. At the prior hearing in May a long argument took place, in which it was sought to show that the agreement of June 1st, 1901, was not duly executed by the Corporation, and that it never came before the Mayor and aldermen, and that the seal of the Corporation had not been properly fixed to it. That contention had now been abandoned at the bar. It was admitted by the plaintiffs that that agreement had been duly executed by the Corporation, and the only point to be determined was whether the agreement first executed was *ultra vires*, and was not binding. The agreement in question was one which related to the construction of tramways at Hastings. There had been authorised at Hastings two systems of tramways or light railways. One commenced at the extreme west-end of the Marine Parade at St. Leonards, and ran westward to beyond Bexhill. The other commenced and finished at the Memorial, in Hastings itself. From that point it went both north-west and north-east, and these two lines were for a considerable circuit in the country at the back of the town. There was thus left between the two systems of tramways a hiatus, namely, the frontage of the town from the eastern extremity of the Bexhill line—the west end of the Marine to the Memorial at Hastings, a distance of 1 mile and 6 furlongs. In October, 1899, or for some time previous, there were communications between Murphy and the Corporation into which his Lordship would not enter. At a meeting of the Council held on October 20th, 1899, a report of the Tramways Consultative Committee was referred to. The result of the meeting was that the report of the Committee was received and adopted, and it was referred to the Tramways Committee and town clerk to take all necessary steps for giving effect to the arrangements. Shortly stated these arrangements were of the following nature:—Murphy should promote the construction of a system of tramways, such as described, in Hastings. With regard to the portion of a circular line between the Borough Cemetery and Hillingdon, Murphy had an undertaking to include it in the promotion, subject to the Corporation entering into an agreement to consent to the application of the promoters or obtain powers for the construction of a tramway between the eastern terminus of the proposed Bexhill line and the Albert Memorial whenever the Corporation deemed it expedient. The terms were that the promoters should pay in respect of such tramway a wayleave of £325 per annum at first and £400 per annum afterwards, the particular conditions to be such as the Corporation might determine. Murphy agreed accordingly to construct this outlying portion of the Hastings tramways upon terms that if and when the Corporation determined upon the construction of the 1 mile and 6 furlongs along the front the Corporation should consent to Murphy's application, and that Murphy should pay certain wayleaves in respect of the line. That stipulation of Murphy's that if he made one line he should have the right of construction over every one else, for the second line could be traced through all the subsequent documents, and it appeared in one of the clauses of the agreement of June, 1901. His Lordship then referred to the measures pursued in Parliament for the necessary sanction. The agreement scheduled to the Bill was to give effect to the arrangement among others as to the construction of the line covered by the 1 mile 6 furlongs, but the Bill as passed did not contain that provision. It was struck out in consequence, as the Chairman of Committees stated that it was not the practice of Parliament to deal with a Bill under which money was likely to become payable in the construction of public streets. Therefore there was on January 7th executed an agreement between the Corporation and Bexhill Light Railways Co., which contained a provision that so soon as the Bill with the deleted clause had been passed into law, there should be another agreement entered into, containing provisions regarding this short line along the front. This agreement, dated April 28th, 1900, was sealed by the Corporation, and his Lordship thought it bound the Corporation. Having stated that the Bill was passed on June 3rd, 1900, and referred to its recital of the intention to construct the Hastings tramway, his Lordship summed up the transaction as being one which made it competent to the Corporation to enter into a binding contract as to the tramway along the front. The argument failed that inasmuch as the Act of 1890 authorised certain contracts, it implicitly forbade other contracts. The learned Judge held that the Corporation was entitled in its control of the ratepayers' interests to construct any works for their benefit, and to make any arrangement beneficial to their interests. Holding the undertaking to come under that category, he held that the agreement was binding on the Corporation, and that the action failed and must be dismissed with costs.

Bow, McLachlan & Co., v. Dutilh, Smith, McMillan & Co.

The case of Bow, McLachlan & Co., Ltd., *v.* Dutilh, Smith, McMillan & Co., came before the Court of Appeal, composed of the Master of the Rolls and Lords Justices Romer and Mathew, on Monday last, on the appeal of the plaintiffs from a decision of Mr. Justice Jelf in Chambers, staying the action and allowing the action to go to arbitration.

Mr. Hamilton, K.C., in support of the appeal, said the plaintiffs were electrical engineers carrying on business in Glasgow, and the defendants were a firm of electrical engineers, who had a big contract from the Southend Corporation for the installation of the electrical tramway system in that town. They sub-let the engineering part of the contract to the plaintiffs, the total amount of which sub-contract was about £8,000. The present claim was for £3,000, the balance alleged to be due under the sub-contract, and £900 for extras. The defendants in their affidavit shadowed forth a counterclaim for £3,500. Under the contract, any dispute arising between the parties were to be referred to the arbitration of the Southend Corporation borough engineer—a Mr. Fidler, and Mr. Justice Jelf, in view of this, stayed the action started by the plaintiffs, and referred the matter to the arbitration of that gentleman. Hence the present appeal of the plaintiffs, who contended that Mr. Fidler's interests were so fully mixed up in the dispute that he could not approach the matter with a sufficiently open mind to give an unbiassed decision upon it. The learned counsel said that the dispute had reference to the supplying by the plaintiffs of two engines, each capable of producing 200 kw. of electricity, and a third engine of 125 kw. Although these engines had been working the tramways for the last 12 months without a breakdown, Mr. Fidler complained that they did not work properly, and he had entered into a contract for what he termed "repairing" the two larger engines, and for replacing the smaller engine, the amount of that contract being the amount counterclaimed for, £3,500. The plaintiffs' suggestion was that, if anything was wrong with the machinery, it was the boilers, which the borough engineer himself supplied, that were in fault. Under these circumstances, the learned counsel contended that Mr. Fidler was not the proper person to arbitrate on the case.

Mr. Roskill, for the defendants, submitted that Mr. Fidler was in no different position to any other borough engineer who might be named in a particular contract as arbitrator. It was well known that, in case of a dispute arising, he would be in possession of the facts, and it had not been shown that he had done anything extraordinary in this matter.

Judgment was reserved.

Electric Railways Co., Ltd.

The petition of H. A. Nepean Fyers and Another for the winding-up of this company, was down for hearing before Mr. Justice Byrne on Tuesday last, Mr. Eve, K.C., appearing in its support. Mr. G. Henderson for the company and certain creditors, said the company was formed for the purpose of working a railway between Paddington and Kennington, and he asked that the petition should stand over to await the result of certain negotiations with the manager of the Great Western Railway Co. Mr. Eve maintained that the company was hopelessly insolvent. The hopes expressed of the Bill going through with the Parliamentary Committee were not yet realised, inasmuch as it appeared on affidavit that there was not sufficient evidence to satisfy the Joint Committee that the necessary money would be forthcoming. Mr. Justice Byrne directed the petition to stand over for a week.

CORRESPONDENCE.

Tramcar Brakes.

I have been following the correspondence in your recent issues dealing with the question of tramcar brakes with considerable interest. Although the experiences of your correspondents lead them to considerable diversity of opinion, taken as a whole, I feel sure that the controversy will be of great interest to those corporations or tramway companies who are puzzling over the vexed question as to how many, and what type of, brakes their particular local conditions render essential for the safe operation of the system. It seems to

me insufficient attention has been paid to the factor of "local conditions," and each correspondent has more or less confined himself to extolling a certain specific type of brake to the detriment of other types. On consideration, the majority of the brakes that have been discussed appear to claim attention as each fulfilling under suitable conditions a useful and proper function as part of a car equipment.

In your current issue "Air and Sand" makes a spirited endeavour to persuade us of the unqualified merits of the air-brake system. While I agree with him that for heavy bogie cars, or where trailers are employed, air brakes are extremely useful as relieving the motorman from physical strain, I feel that some of his points are open to criticism. It is usual for air brakes to be rigged so that they operate the same shoes as the hand brake, and in the case of bogie cars, the connection between the two rigs is made on the equalising lever. Consequently, the air brake becomes merely a glorified hand brake, with the important advantage of quick application and release. Hence any failure in the brake rig between the equalising lever and the brake shoes puts both brakes out of service, necessitating, in my opinion, a third brake.

The Hewitt & Rhodes pneumatic slipper brake has the advantage of being an entirely separate unit. This brake, by virtue of its nature and construction, is somewhat wasteful of air, as, with each application and release, the four brake cylinders, and the piping between them and the service valve, are all charged with live air, and again exhausted to atmosphere. The cost of maintenance for air-brake equipments is considerable, and I have found the compressors and automatic governors to require constant attention.

In "Air and Sand's" letter, paragraph 4, it appears that he is under the impression that electric brakes derive their power from the trolley wire. What he says about the extra duty on the car equipment I wholly concur in, but surely with axle-driven air compressors the car motors are called upon to furnish the braking energy, plus the losses embracing constant compressor friction, leakage, &c., while when the motors are used for direct braking, the whole of the energy is used for retardation.

By electric brake he refers, no doubt, to the ordinary rheostatic brake, which just now has become most popular, but being so dependent upon the car electrical equipment, I do not consider it a safe stand-by for cars that have to run over routes with heavy gradients, but it is a useful brake inasmuch as it relieves the motorman from the physical exhaustion of using the hand brake to any extent. Its adoption constitutes an almost negligible increase in the price of the equipment as compared with air brakes.

In paragraph 5 your correspondent informs us that with air brakes it is easy to adjust the maximum (reservoir ?) pressure so as to prevent skidding of the wheels. That is so, but presumably he would adjust the pressure in such a manner that a maximum braking effect can be obtained with a good rail. If he adjusts it for a bad rail he will never get his maximum braking effect when the rail is good!

Your correspondent tells us of the danger of fire, both real and imaginary, from the use of the electric brake; you can imagine a tremendous lot of things if you give your mind up to it for an hour or two and suffer at all from nervous disorders, but the realisation is quite a different matter, and it would be interesting to have a statement as to how many cars have suffered in this respect during the last 24 months, say, in Liverpool, Glasgow, Manchester and Cardiff, each of these large systems employing electric brake controllers, and so far as I know representing between them the principal makes and types of electric brake controllers.

Dealing with what your correspondent says about track brakes, let me say at once I do not think that the wear from the wooden shoes on the rail can seriously affect the life of the rail, and wooden shoes are almost universally employed, with the notable exception of the magnetic slipper brake. This latter brake, in my opinion, is unsuited for a stand-by, owing to its intimate connection with the rest of the electrical equipment.

In examining the report on the Glasgow accident (Electrical Review, October 24th, 1902) we see that the advantage in braking lies slightly in favour of the Newell brake as against the electric brake, and it is a question whether the advantage shown outbalances the extra complication with the consequent extra chances of breakdown and increased maintenance charges.

The following appears to me to be somewhere near the mark as regards the brake equipment of tramway cars:—

1. Single truck, single or double-deck cars, weighing empty not more than about 3½ tons, for easy routes having a maximum grade of, say, 1 in 25. (*a*) Ordinary hand brake for working purposes. (*b*) Electric emergency brake or rheostatic brake.

2. Cars as above (1) running over severer routes. (*a*) Ordinary hand brake for working purposes. (*b*) Electrical emergency brake or rheostatic brake. (*c*) Spencer or other type of reliable slipper brake worked by hand wheel, to be used for descending hills, or in case of failure of the other two brakes.

3. For heavy bogie cars worked on easy grades. (*a*) Ordinary hand brake. (*b*) Electrical emergency or rheostatic brake. (*c*) Air brake working on wheel shoes for service purposes.

4. For the same cars as above (3) running over severer routes. (*a*) Hand brake. (*b*) Electric rheostatic brake. (*c*) Pneumatic slipper brake for service purposes.

It will be noticed for the easier grades I recommend two *separate and distinct* sources of braking effect, and for severer conditions three. I recommend the hand-worked slipper brakes to be operated by wheels, as levers take up too much room on the platform when pulled over, though the brakes are undoubtedly more quickly brought into service thereby.

Very little has been said as regards sanding arrangements. My own experience of this important factor of a car equipment is disappointing. There is room for the introduction of a thoroughly reliable sand gear which will neither leak all its sand away unbeknown to the motorman, nor stick or clog at the least provocation. A good deal of trouble is caused by the flimsy nature of the rigging which car builders seem to put in from the platform to the hoppers, whereby a lot of useful motion is lost in the spring of the rods. In such a case as the Glasgow accident, *i.e.*, a run-back, there is usually no provision for sanding the rail at the back of the car owing to the prevailing custom of changing the sand punches from end to end. Without sand on a greasy rail it is very difficult with any wheel brake to make a quick stop, and I have found the state of the rail make considerable difference to track brakes; these one cannot assist so much as wheel brakes by the use of sand, as the shoes push it off the track before them.

I trust you will excuse the somewhat lengthy nature of my letter, and that your readers may find some slight interest in it.

Release Spring.

November 2nd, 1902.

I consider it advisable now to draw the attention of your readers to certain information which substantiates the advantages and reliability of the Hewitt & Rhodes pneumatic track brake, which I have pointed out several times; and also substantiates my criticism as regards the numerous weak points and unreliability of the magnetic brake. In the issue of this paper, October 24th, p. 697, "Driver" says:—

"I have used the air slipper brake several times during the time I have worked on an electric car, and can honestly say that it has saved me many an accident that would have occurred if I had not had one on my car, as the hand brake on some occasions will not act properly when you are placed in a difficult position."

Now, he does not mention whose brake it was, but it was an "air slipper" brake. Surely the information supplied by a man who is practically engaged in manipulating a car and brake day after day must have some weight.

Re issue of October 31st, pp. 730 and 731, by "Air and Sand," this article practically substantiates all I have said for the merits of the pneumatic brake, and my criticisms of the magnetic brake. In the same issue, p. 732, "Engineer" says:—"The efficiency of the Hewitt & Rhodes slipper brake, both for service work and emergency purposes, is beyond dispute, and is freely admitted by all who have used it." In the issue of October 24th, p. 693, last paragraph of Major Druitt's (Board of Trade) Report *re* Glasgow tram accident, he says, speaking of the

magnetic brake :—"The brake is, I believe, very powerful, but as I understand its efficiency depends upon flexible connections being in good order, its superiority to a purely mechanical track brake has yet to be tested." There was also a report on similar lines *re* Huddersfield tram accident.

Now this delicate, yet conclusive, criticism is only one of the weaknesses I pointed out in regard to the magnetic brake over six months ago. Since that time, after investigations by the Board of Trade inspectors, it is found that such weaknesses and unreliability do really exist. The magnetic brake has had a practically open field to test its merits, but such it has failed to do; the more it is looked into, the more it is open to severe criticism. As regards being a reliable emergency brake, it has no claim as such, and is only "fit for the scrap heap." We must look elsewhere for a thoroughly practical, simple, reliable emergency brake; such a brake is to be found in the Hewitt & Rhodes pneumatic slipper track brake.

A test which I made at Stockport, near Manchester, some months ago, *re* this brake, was as follows: Going down a grade of 1 in 11, speed 20 miles an hour, brought to rest in *one* car length, without any jolting or discomfort to passengers. From extensive inquiries I have made all over the country, I find that all the Oldham Corporation trams (about 70 cars) are equipped with Hewitt and Rhodes emergency brakes, the majority of the Stockport Corporation cars, about a dozen cars at Rochdale, and one car fitted at Dundee to test its efficiency, &c. In your issue of October 31st, p. 731, last paragraph but one, Mr. J. W. Manley says:—"I have heard that the Potteries cars had such brakes (pneumatic) attached at great cost, but they were discarded through unreliability, and the abnormal cost in upkeep, &c." I can assure him they were not Hewitt and Rhodes pneumatic brakes, because I have it on good authority, and know it to be a fact, that just recently an order has been placed to equip 20 or 30 cars with the Hewitt and Rhodes brakes in the very district to which he alludes, viz., the Potteries district.

Wm. R. Bowker.

Halifax, *November 3rd*, 1902.

The discussion which has upon your invitation been started in your columns about this important subject seems likely to throw light upon many of the difficulties of the problem, upon the requirements of tramways in this respect, upon weak points of existing apparatus, and upon the factors which every successful designer will have to deal with.

I therefore think that those of your correspondents who mentioned facts can claim more merit than those who claimed that a certain system which they had tested was the panacea for all evils of the road.

Among the former class "Driver" seems to have touched the most important points till now by asserting that the motorman is dead tired when his shift ends, and that motormen wish generally and earnestly for the substitution of power brakes for the hand-service brakes now in use.

If this claim is admitted to be reasonable, it would at once reduce the number of possible solutions of the problem, as only two more questions would have to be replied to, viz.:—

1. Which power is likely to succeed best? and
2. Which system (not which brand) is likely to give the best emergency brake?

The question "Driver" raised seems to be a most important one from the point of public safety, and should, therefore, be earnestly looked into by the Board of Trade.

If motormen are tired out at the end of their work as described, it would be obviously dangerous for an emergency call to be made upon their energy and judgment (or even instinct, if Mr. Phillimore's perfection of drill is assumed) during the last hour or two of their shift.

It must also not be overlooked that it would, under such exacting conditions of service, be only natural that motormen would husband their energy as much as possible during the whole of their hours of service. Late and vehement braking would be the result, and the many buckled splash-boards and scratched side-panels of tramcars seem to suggest that the brakes were not only put on late, but too late.

If I may be allowed to suggest replies to the two questions named above they would be:—

Pneumatic brakes seem more likely to make the best service brakes, because they can easier be combined with automatic sanding apparatus than any other system, and no brake is reliable without efficient sanding. The pneumatic brakes are independent of trolley and controller contacts; they cannot set fire to cars or even make the fuse go, and drivers invariably prefer them to electric or magnetic brakes, because they are no mystery to them like the latter. Lastly, if an air brake should fail, it does not matter, as the motorman knows that no harm can result by applying his emergency brake as sharply as the latter will stand.

This brings us to the second question, viz., which system is likely to give the best emergency brake?

And to this question I think most replies will be: a good hand brake.

The hand brake has the least number of parts, can with little expense be made strong enough to defy failure, and if only used as emergency brake can always be kept in tip-top condition. The fact that it would require a greater effort on the part of the driver to handle it would not count on cars equipped with power service brakes, as drivers on such cars should be "fit" to the last minute of their shift.

I hope that the expense will not be raised against power brakes. £40 to £50 per car must not be considered where lives are at stake, and as to maintenance, I am told that 45 good power brakes require one fitter to keep them in order.

Consultant.

Single-Phase Railway Working.

I have read with great interest your abstract of a paper by Mr. Lamme on a proposed American single-phase railway, and I thought it might interest you to know that the development of single-phase motors on apparently similar lines has received active attention also in this country. It is only the combination of unfortunate circumstances which has prevented me from making known before now some of the results already obtained.

It was early in 1898 when I designed my first alternate-current two-phase motor with power factor equal to unity. The chief novel points of this machine, which possessed all the mechanical features of the ordinary asynchronous motor, were the addition of a commutator and that of a short-circuited winding placed in the same slots with the exciting winding. This short-circuited winding allowed the motor to run asynchronously, and was used for starting.

Having about that time got into communication with a Bradford firm, then trading under the name of Rosling and Appleby, and having eventually joined them, my first energies were devoted to the design of a complete series of direct-current motors and generators; this was followed by a period of very great activity in the manufacturing line, leaving only very little time for experimental work, more especially as the works of that firm were then only small. The formation of the new company, now trading under the style of Rosling & Fynn, Ltd., then absorbed all our time, and, finally, the building of the new works, and the removal, checked all enterprise in that direction.

The experiments were, however, again vigorously taken in hand from the moment that work could be begun on the new premises, and have yielded sufficiently good results for the firm to take an interest in the patents.

The original idea of simply providing an improved poly-phase motor suggested the far more important solution of that problem which has baulked so many, and the solution of which would prove such a boon to the alternate-current stations of this country. I am referring to the single-phase motor, capable of starting under the same conditions as a direct-current motor, susceptible of a variation of speed within a reasonable range, independently of the frequency of the supply, and capable of working with a power factor approximating unity.

I hope to be in a position very shortly to give full particulars of tests, as a number of these motors in their latest form are now nearing completion at the works of Messrs. Rosling & Fynn, Ltd.

For reasons which I can fully appreciate, Mr. Lamme has given very few details indeed concerning his new motors,

but, from what he has said, I conclude that his motors will prove to be somewhat different from mine; at any rate, I have followed lines which differ materially from what may be termed good continuous current practice, nor have I so far found it necessary to choose such very low cycles as 16⅔. There is no doubt that such low periodicity will be of advantage in facilitating the commutation, but it may have been chosen solely for the purpose of minimising the loss in the iron return.

The variation of voltage to be supplied to the motor, I obtain in a different, and, I hope, more efficient way, with total absence of sparking.

There is, in my mind, not the slightest doubt as to the possibility of successfully operating railroads on the single-phase system, and I feel certain that in the near future it will be extensively used.

V. A. Fynn.

Bradford, *October 28th*, 1902.

Notes on the Practical Working of Rotary Converters.

I should like to add a few remarks in respect to the article on the above subject which appeared in your issue of the 17th ult., and especially with reference to Mr. Kelleway's letter which appeared in your issue of the 24th ult. In this letter Mr. Kelleway appears to suggest that it would have been better to have employed a synchronous motor-generator instead of the rotary converter for the purpose of obtaining flexibility of conversion on either side of the system. Were the question simply that of obtaining this flexibility of conversion, doubtless the motor-generator would have been preferable, but this was not the only consideration involved.

Without wishing to enter into the question of the relative advantages of the various types of converting machinery, I would point out that in the system referred to it was decided to adopt rotary converter equipments for the sub-station machinery, and it is, I believe, generally admitted that for power work the advantages of greater efficiency and overloading capacity are such as to make this type of machinery preferable, even assuming that the disadvantages of low frequency and the difficulties in parallel running and satisfactory reversibility of function are as great as is generally supposed.

In a well-designed system, I do not think these disadvantages are so very great, and that they are by no means insuperable it was the object of my article to demonstrate. The question, then, is not one as to whether a motor-generator might not have been better, but rather whether, having regard to the advantages of the rotary converter equipment for the purposes referred to, and which alone justified its use, it was not quite easy and possible to overcome the difficulties usually attributed to this class of machinery. The arrangements adopted and described in the article were certainly extremely effective in overcoming these difficulties, and I might add that the extra cost of the separate exciting set did not exceed 2½ per cent. of the cost of the single rotary converter equipment.

If, then, the rotary converter is considered to be the best type of machinery for a particular installation, and it is quite practicable to overcome such difficulties as might militate against their use, there certainly appears every justification for so doing, and the rotary converter equipment becomes, in consequence, of greater value as compared with motor-generator equipments.

J. R. Salter.

Breakdowns of Electrical Machinery.

I have read with much interest your article *re* "Breakdowns of Electrical Machinery"; the more so as one of the cases cited evidently refers to a breakdown which occurred in one of the sub-stations of the company of which I am an employé. The case in question is that of a motor-generator transforming from 1,000 to 100 volts, the attendant accidentally breaking the field connection with disastrous results to the armature.

The attendant was afterwards severely remonstrated with for not breaking the switches when the accident occurred. Now, as a matter of fact, the switchboard was placed behind the machine in such a way that it would have been impossible to have reached it without personal injury. This demonstrates the importance of fixing a switchboard at a safe distance from the machine or machines it controls. This point does not seem to be given the attention it deserves. Sub-stations are built much too small for the machinery they contain, and the switchboards are in many cases erected in very inaccessible positions, being in some corner of the sub-station behind the machine, so that one has to walk round the machine in order to operate the switches, and often scarcely a foot of space exists between the switchboard and the machine.

If engineers would only pay more attention to the positions of the switchboards relative to the machines, attendants would not get so confused in cases of accidents, and would be better able to realise what was taking place; but when one is imprisoned in a corner of a sub-station bounded on one side by the machine and on another by the switchboard, can he be expected to remain at his post and attend to the switches with commutator segments and melted copper flying about him with all their fury?

The suggestion that the field magnets should be auxiliarily excited by the H.T. current when starting up, and that a cut-out should bring the H.T. excitation into play in case of failure of the L.T. exciting current is an excellent one, and should be universally adopted.

J. O. T.

Engineers, and Others.

I have read with considerable interest the correspondence with regard to "Students" and "Mechanical Engineers for Electrical Stations," which has lately appeared in the Electrical Review.

So much has been said in both cases that it will not be out of place, perhaps, to say a few words with regard to another body of men who have a perfect right to be considered students of engineering, and, in some cases, worthy of the name of engineers. I refer to those who cannot afford to "go through the shops," and who are prevented by some cause or other from obtaining a college training.

I believe I shall be right in saying that there are many such, and also that some of the best engineers (both electrical and mechanical) of the present day are, or have been, in that position; their only means of making themselves what they are has been sheer ability and a capacity for hard work and study. In my opinion, engineers, like poets, are born, not made; and I am sure anyone who will take the trouble to inquire into the lives of engineers, and into the lives of a good many who call themselves engineers, but are not, and never will be, will agree with me.

It is a well-known fact that to-day and for some years past, youths are, and have been, pitchforked into the engineering professions who might have made good lawyers, clergymen, or anything but engineers, just because their parents have been able to afford them a college training and to pay the premium required to enable them to "go through the shops."

Some of the results are—

1. The engineering professions are so overcrowded that it is an impossibility for even a good engineer to obtain more than a mere pittance for what is really valuable work.

2. There are a great many men to-day holding responsible positions as engineers whose only qualification is that they are able to talk; what I mean is, that they are quite capable of explaining away any mishap that occurs to the machinery under their charge, making people believe they are nothing short of martyrs, and generally talking so fast that it is quite an impossibility to reason with them. To hear them they will make anyone believe that what they do not know about engineering is certainly not worth troubling about. I might add that they are really a laughing-stock to at least one-half of the men under them.

3. They are occupying positions that ought to, and could be filled by men who are worthy the name of engineers, but who, in a good many cases, have neither been able to "go through the shops," nor to have a college training.

Let a man have a college training and go through the shops by all means, if he can afford it, and is an engineer to begin with; but I am confident that no amount of training can make an engineer if he is not already one.

What I would urge is that men should not be despised because they have been unable to afford these advantages, but who, nevertheless, are born engineers, and, by making the best of their opportunities and by hard study of the books they have been able to procure, are well qualified to hold, and do credit to, the positions which, in many cases, are to-day held by men such as I have described above.

I would just like to mention the name of one man who did not go through the shops or have a college training, but whose name is revered by all true electrical engineers; I mean the truly great and, at one time, much-abused Michael Faraday. But for him, who can say that the great branch of the electrical engineering profession would have existed at all?

I do not flatter myself that anything I can write will do any good in a direct way, but it may be a little encouragement to students who cannot afford to go through the shops, &c., and I trust some abler pen than mine will take the matter up.

Let us hope that at some time in the near future engineers, and not talkers, will hold all the responsible positions on their merits only, and not be kept in their positions, as the talkers are to-day, by influence.

As I consider that an engineer is always a student, I sign myself

Another Student.

Correction.

I beg to draw your attention to an error in the legal intelligence column of your journal last week. You state that this company, viz., "Electric Lighting Boards, Ltd.," was in the Winding-up Courts. This should have been "Electric Lighting Boards (British Manufacturing Co.), Ltd.," an entirely different company.

For Electric Lighting Boards, Ltd.,
E. F. Putz, *Secretary pro tem.*

Efficiency and Power Factor of Small Three-Phase Motors.

In your issue of October 31st, some curves and figures are given for small induction motors of Continental make. These motors are of the squirrel-cage type, and their performance at starting is described as follows:—"Starting upon a loose pulley, the current consumption does not exceed the value at full load. Starting with full load torque, the current consumption is about twice the full load current."

It would certainly be of great interest for many of your readers to know how these results are obtained, *i.e.*, what additional apparatus, if any, is required for reducing the current to the given values, and what starting torque and current these motors will give at the full voltage.

H. S. M.

Professional Etiquette.

Allow me to second Mr. W. H. Booth's excellent propositions on this subject. In the first place, I would ask the Council of the Institution to inquire into the antecedents of the consulting engineers in this country who have been favoured with the greatest number of the best-paying commissions, and who are therefore considered as of "high standing." How many of them were electrical engineers when they pocketed their first commissions as such?

Some of these engineers of high standing gained admittance to the profession by questionable means, their previous experience in electrical engineering being absolutely nil, while men who contributed largely to the science and art of electrical engineering by scientific work and writings have been notoriously overlooked. And these knobsticks have attained a position in the Institution and the country, the most lucrative in all the range of electrical work.

If a line of demarcation is to be drawn between the several branches of engineering, most assuredly the electrical engineer would suffer most, for in any installation the mechanical, civil and architectural works are not less than 70 per cent. of the whole work, so that it is the "high standing" electrical engineer who poaches on the grounds of his *confrères* in nearly every case. It is quite common for so-called electrical engineers to take on the whole of the works.

The note to the town clerks savours of the trades union business. I fail to see wherein it differs from the trades unionists sending round notices to employers warning them against employing non-union men. And I am of opinion that the trades union societies are a trifle more particular about the qualifications of their members than the Institution is.

I am an old consulting engineer, and never have advertised either directly or indirectly, but I claim the right to do so if needful, and I consider it a most dishonourable and malicious act for any society, whether of bricklayers or electrical engineers, to do anything whatever to interfere with my rights to offer my services for money in an open and straightforward manner, either to private or public employers. The act is all the more cruel at this juncture, when the "high standing" men have made fortunes out of municipal credulity. The public are prejudiced against younger and better qualified engineers asserting themselves by these efforts of a Society council.

Consulting Electrical Engineer.

Question of Trade Etiquette.

I am rather surprised to see a letter from "Puzzled" in your issue of October 24th, as I thought my letter in your issue of the 10th ult. was quite clear.

I quite agree that if the case was as stated by "Puzzled" (*i.e.*, that the contractor simply installed the wires ready to connect to the fan, but did not connect up or start it), the contractor would not be entitled to commission; we expect manufacturers to give the trade better terms than those outside, and think that if a contractor is asked to connect up and run a fan or any other article that he has not supplied, he is entitled to a payment of some kind for his responsibility and trouble, even though he may only have to turn on a switch and let the fan run; for if anything went wrong, the fan-maker would at once blame the contractor, and expect him to put the fault right.

William Cross.

Northern Section of the National
Association of Electrical Contractors.
Newcastle-on-Tyne, *November 3rd*, 1902.

THE COMPLETION OF THE PACIFIC CABLE, AND ITS LESSONS.

After much obstruction and long delays, the Daily Press of last Saturday was able to make the announcement that the Pacific Cable had been completed early in the morning of the 31st of last month, and since that time, numerous congratulatory telegrams have passed over this new line between the officials of the various colonies now brought into closer communication with the mother country, and the Colonial Secretary and others who have taken a prominent part in making effective this useful factor in the unity of our Empire. It is satisfactory to notice that amongst these compliments the name of Sir Sandford Fleming, as the originator and promoter of this work, has not been forgotten. In the hour of accomplishment, it not unfrequently happens that this fact of itself overshadows everything else, and that the long period of earnest work which may have been devoted to rendering such achievements possible, and to which their ultimate success is mainly due, is relegated to oblivion. To deal in anything like just proportions with a subject such as that which we have before us, it is, in the nature of the case, advisable to take a retrospective view, and this for two good reasons. The first of these is, that the completion of this cable affords us a striking lesson, probably as yet unique, of the advantages to be gained by the united action of Great Britain and her principal Colonies, in questions of Imperial concern, and towards which all the parties interested have willingly contributed. Beyond this, the constitution of the Pacific Cable Board, composed, as it is,

of representatives of the Governments of Great Britain and her leading Colonies, offers quite a new instance of federated action. The second reason for dwelling upon the history of this enterprise is, that we may learn from it a lesson which should warn us against the obstacles which may be thrown in the path of such projects in the future, and may thus offer guidance as to how these may be overcome. For many years we have steadfastly advocated in these columns the necessity for such a cable; but whilst pointing out the advantages attending it, we have, as our readers may remember, also made it clear that, however important this link is in itself, its importance will be much more considerable, and its value will be greatly enhanced, when a complete scheme of State-owned cables has become a reality.

The history of this undertaking is very well given in an article which appeared in the *Times* of last Saturday. From this it will be gathered that for the last 18 or 20 years this project has been in existence, in pretty much the same shape as that in which it has at last been realised. In 1886 an offer was made to undertake this work for a payment of a total annual subsidy of £100,000 for 25 years, to be divided in determined proportions between the Home and Colonial Governments. Even then the question of the benefit to be derived from an Imperial guarantee, as opposed to the guarantee of each colony separately, was raised, and it was pointed out that should the British Government become responsible for the payment of the whole amount on behalf of the Colonies the subsidy asked would be reduced to £90,000 per annum. A similar point was raised after the issue of the report of the Colonial Secretary on the "Pacific Cable Commission" in 1899, when it had again to be pointed out that the money for such a purpose could be borrowed at a very much lower rate of interest on an Imperial guarantee, than would be the case if it were dependent on the guarantee of each colony separately, a method of finance which was adopted after some delay. The story abounds in delays, and it should be remembered that at each check effected by the opponents of the Pacific cable project, a considerable time, sometimes years, had to elapse before the truth could be elicited. This it is not difficult to realise, when we bear in mind that the various Governments interested are scattered over the globe, and that not unfrequently, in Australasia, inter-Colonial jealousies have stood in the way of joint action. It may not be out of place to give an example of this, and we cannot do better than quote from the *Times* article, to which we have referred:—

> At the Colonial Conference of 1887 the chairman of the Eastern Co. declared the bed of the Pacific to be covered with coral patches fatal to the life of a submarine cable, and the Postmaster-General of South Australia, interested in the Eastern route on account of the landlines owned by his Government, gravely announced the depth to approach 12,000 fathoms, or 14 statute miles. As a matter of fact, the greatest depth of the present cable is only 3,200 fathoms, and the average depth 2,700 fathoms. In the face of such statements the Colonial delegates could only pass a resolution to the effect that the Pacific cable was a "project of high importance to the Empire, and every doubt as to its practicability should, without delay, be set at rest by a thorough and exhaustive survey." With this object in view they wrote a letter to the Secretary of State for the Colonies, Sir Henry Holland (afterwards Lord Knutsford), asking him to cause the survey to be made. Sir Henry Holland's reply proved a model of diplomatic evasion. It was to the effect that the survey could not be made unless there was a prospect of laying the cable. This answer being equivalent to the well-known advice not to enter the water until one has learnt to swim, left the delegates on the horns of a pretty dilemma. However, the Postal Conference at Sydney in 1888 renewed the request, and it was arranged that the *Egeria*, on a three years' commission to survey the Pacific Ocean, should take soundings along the route between New Zealand and Vancouver.

On other occasions officialdom has shown an activity which would be remarkable and praiseworthy were it not capable of an explanation, which may also throw light on the cause of official delays. This explanation is afforded by the following extract from the report made to the Canadian Government by Sir Mackenzie Bowell, who, with Sir Sandford Fleming, had gone on a mission to Australia in September, 1893, to promote the interests which that Colony had in common with Canada. The extract runs as follows:—

> In submitting our views on the subject of the cable to the several Governments, we found that they had received documents in a recent despatch from the Colonial Office, London, which by their character and source were by no means helpful to the object of my mission. These documents consisted of a letter from the General Post Office, London, of date July 5th, 1893, and a report from the Hydrographer of the Admiralty dated February 28th, 1887. From the copies which I append (Appendices A and B), it will be seen that the documents which confronted us raised difficulties to the establishment of a Pacific cable, of various kinds—difficulties as to cost, traffic and revenue, technical difficulties arising out of the physical condition of the ocean, which can only be met by the action of the British Admiralty, and difficulties which can only be set at rest by a thorough nautical survey.

In reference to the production of the report of the hydrographer seven years after it had been written, Sir Sandford Fleming made the following remarks:—

> I venture to add that with the light of added experience, and under the new conditions which have sprung up, I doubt if Captain Wharton, or any other British officer, would write the same report to-day. It seems to me unfair to that gentleman to reproduce an old document, perhaps hastily written, with but little data before him, and to hold him responsible at this hour for the opinion which he then expressed.

Besides the cases above cited, which by no means exhaust the list, it must be remembered that at several of the conferences, the delegates, not being technical men, had to take their information from sources on which they might fairly expect to rely for correct information, especially when, as in the case of Sir Charles Todd (the Postmaster-General of South Australia, who so outrageously misled the South Australian Representative at the Conference of 1887), the authority relied on expresses himself as follows—with a confidence worthy of a better cause:—"As the Government are aware, I have given the subject very great and careful consideration, more so, perhaps, than anyone else." A considerable amount of the delay was also due to the egregious estimate of cost furnished by the Home Post Office officials, who estimated the cost of a Pacific cable at £3,264,000, as against a tender of £1,517,000 sent in by the Silvertown Company.

Those who have followed the matter closely can be at no loss to understand the causes of the delay in bringing this work about. Apart from the instances referred to above, the vested interests involved were of such an important character, that it is hardly to be wondered at that almost everything was done that could possibly be done to avert or destroy the scheme. That the action taken by the companies concerned was injudicious, to say the least of it, even as far as their own real interests were concerned, has often been pointed out by us, and experience has shown, as the years went on, and as fresh developments in cable routes were effected, that the conservatism of the opposing companies was built upon a foundation of prejudice, and of ignorance of their own real interests. Step by step these companies have been forced, unwillingly, to reduce their rates to various parts of the world, receding before the gradual advance of the Pacific and kindred schemes, only to find that these reductions, which they were forced to make, turned out to be of the greatest financial advantage to themselves, apart from the facilities which the telegraphing public derived from the lowering of rates.

There is, however, a brighter side to the subject, to which we turn with relief, after having been obliged to refer to the shadowy side of the shield. The successful laying of these cables across the Pacific has brought within immediate view the possibilities of a system of State-owned cables. Such a system has long been advocated by Sir Sandford Fleming, and for some time back Sir Edward Sassoon, who is the chairman of the Parliamentary Telegraph Committee, has strongly recommended State ownership, adding considerably to the list of cables which Sir Sandford Fleming has recommended. In the evidence which he gave before Lord Balfour of Burleigh's Committee, which was appointed by Government as a consequence of his efforts in the House of Commons, Sir Edward Sassoon laid before the Committee a very complete scheme for the purchase of some of the existing cables, as well as for the laying of new lines which would unite by all-British routes many important portions of the Empire, which are now dependent on foreign lines—or would duplicate by a widely distinct route some of the British cables which at present pass through water where they could easily be interrupted. Besides these, it is suggested that cables should be laid by the Government to some of our outlying

possessions, where commercial inducements alone are not sufficient to warrant the laying of cables. As an example of this we have a line from the Cape *viâ* Tristan da Cunha to the Falkland Islands. It is well known that the first and last of these places are important naval bases. The nearest British coaling station to the Falklands is, on the one hand, Vancouver, some 9,000 miles away, and on the other hand, Simon's Bay, some 3,500 miles off. There were, of course, suggested various other lines of importance, which space will not allow us to mention here. In the report of the Committee, the only cables recommended to the attention of H.M. Government were, one from the Cocos Islands to India, and another from Jamaica to the Island of St. Lucia, a naval station in the West Indies. The former would allow of telegrams reaching London over British cables *viâ* Australia, and Canada, in case of interruption to the present cables to the East, which all touch on foreign soil. The last-mentioned cable is much required in any case, as we find that during the last year the West Indian cables in the chain with which St. Lucia is connected, have been interrupted no less than 18 times. The fact has been insisted on by Sir Charles Dilke that our safety can only be guaranteed by a multiplicity of cables. This opinion is well worthy of attention. Not long ago we were gratified to hear of new cables which had been laid to the Cape *viâ* Ascension and St. Helena, both important outlying British possessions, but only a few days ago we learnt that the cable between Ascension and St. Helena had broken down, which shows the advisability of a duplicate line to these points. The need for the multiplication of cable routes has been felt elsewhere as well as in England; and at present the Governments of the United States, of France, Germany, and even Holland, are taking active steps to fortify themselves in this direction.

We are glad to learn from the recently issued report of the Conference held in London between the Secretary of State for the Colonies and the Prime Ministers of the self-governing Colonies, that the following resolution was passed by them:—

> That it is desirable that in future agreements as to cable communications a clause should, wherever practicable, be inserted reserving to the Government or Governments concerned the right of purchasing on equitable terms, and after due notice, all or any of the cables to which the agreements relate.

This is a necessary prelude to the adoption of State-ownership of cables, and we hope that Mr. Chamberlain will display the same energy and determination in this cause as he has shown in regard to the Pacific cable scheme.

We have tried to lay before our readers the lessons which the history of the Pacific cable has taught, as well as the prospects of improved communication, which the successful establishment of this cable has rendered possible. We are encouraged to hope that both these aspects of the question may be clear to all the Governments concerned, and it only remains to us to express our hearty congratulations to Sir Sandford Fleming, Lord Strathcona, Sir Charles Tupper and others who have worked so persistently, and against so many difficulties, to bring to a successful issue the work which they have at last effected.

OUR LEGAL QUERY COLUMN.

[Questions addressed to the Editors for insertion in this column should be written on one side of the paper. Free use of fictitious names, &c. may be made. Answers are furnished by a duly qualified lawyer, but the Editors cannot undertake to be responsible for the accuracy of the views which he may express.]

We regret that owing to the indisposition of our Legal Correspondent, there has been some delay in the publication of an answer to the query printed below.

"Argyll" writes:—"We should be glad if you would kindly inform us as to the procedure necessary to obtain an electric light order for a small town.

"(a) Assuming that we should carry out and maintain the supply ourselves.

"(b) Assuming that we carry out the installation and hand over to the town when complete.

"The town we have in view is governed by an Urban District Council, and we should only go in for the scheme if we met with no opposition. We do not anticipate any opposition, as there is at present no gas, and as the local authorities are anxious to popularise their little town as a health resort. We anticipate that scheme (*a*) would be the one adopted, and we wish to know whether there is any means of obtaining an Order without any great cost or delay. The question whether it would pay or not is one which we should consider."

*** "Argyll" assumes that there is some difference in the procedure to be observed on application for a provisional order if the undertaking is to be sold to the local authority, but there is no provision in any of the Electric Lighting Acts which makes any alteration in the procedure. The procedure which he should adopt may be epitomised as follows:—

1. On or before *July* 1*st* promoters must give notice in such manner as the Board of Trade may direct or approve to the local authority in the district of their intention to apply for a provisional order, or of the fact that a provisional order has been applied for. (45 and 46 V., c. 56, Sec. 4, sub-Sec. 1.)

2. On or before November 1st, promoters must give notice of their intention to apply for a provisional order to every rival supply company or undertaking in the district.

3. During the months of October and November the undertakers must give notice by advertisement of the application for, and the objects of the provisional order, and a copy of this advertisement must be deposited at the Board of Trade and at the offices of the company.

4. On or before December 21st the promoters must lodge a memorial for a provisional order with the Board of Trade. This memorial must be addressed to the Board of Trade, signed or sealed by or on behalf of the applicants, and must be headed by a short descriptive title, and must be accompanied by a draft of the provisional order and other documents.

5. The Parliamentary agents or solicitors must be prepared to prove compliance with the Electric Lighting Acts, and the rules by January 15th, and all such proofs must be complete on or before February 22nd.

6. Date of provisional order. A provisional order is never granted until after the expiration of three months from the date of the first publication of the statutory advertisement, nor until opportunity has been given to all to make representations or objections to the Board of Trade with reference to the application. [E.L.A., 1882, Sec. 3 (5).]

Should "Argyll" require further information, he would do well to consider an article which appeared in the Electrical Review, July 24th, 1902, at p. 167, continued in the following number at p. 172.

*** We hope to publish answers to "G. V. S," "Hackall" and "Regular Subscriber," in our next issue.

BUSINESS NOTES.

Electrical Wares Exported.

Week ending Nov. 5th, 1901.		Week ending Nov. 4th, 1902.	
Adelaide	£70	Alexandria	£21
Alexandria	159	Auckland	6
,, Teleg. mat.	696	Bombay	798
Amsterdam	225	Calcutta	1,362
Bombay	823	Cape Town	362
Calcutta	2,066	,, Elec. cranes	10,400
,, Teleg. mat.	60	Colombo	136
,, Teleg. cable	975	Copenhagen. Teleg. wire	49
Cape Town	251	Durban	201
Colombo	181	East London	1,113
Copenhagen	271	Fremantle	85
,, Teleg. wire	66	Gibraltar	89
Durban	449	Hamburg	195
,, Teleg. cable	734	Hong Kong	140
East London	224	Launceston	23
Flushing	5	Madras	93
Fremantle	10	Malta	145
Hamburg	32	Melbourne	72
Hong Kong	99	,, Teleg. wire	2,506
La Plata	33	Perth	263
Lyttleton	99	Philadelphia	10
Madras	88	Port Elizabeth	256
Melbourne	202	Progreso. Teleph. mat.	70
Moji	1,095	Rangoon	12
Nagasaki	8	St. Petersburg	683
New York	29	7 cwt. teleg. wire	—
Ostend	8	Shanghai	29
Penang	54	Stockholm. Teleg. wire	28
Perth	34	Sydney	365
Port Said	55	,, Teleg. wire	118
Singapore	24	Trinidad	35
Sydney	187	Valparaiso	30
Wellington	1,317	Wellington	315
		Yokohama	107
Total	£10,121	Total	£30,071

Foreign Goods Transhipped.

Durban. Elec. goods .. Value £70 | Sydney. Elec. appliances Value £60

Heathman's Ladders.—Continual experience of the needs of electric lamp trimmers has led Mr. Heathman to make some improvements to his wheeled ladders so that the trimmer can get through his work more quickly and easily and with greater safety against falling from the ladder, in the event of his receiving an electric shock. His new extensive factory at Parson's Green is now fully employed.

Catalogues, &c.—A leaflet giving a table of conductivity of alloys of iron has been issued by the Forest City Electric Co., of Manchester, as a supplement to their publication, "Rail-bonding and the Protected Rail-bond."

Messrs. E. P. Allan & Co., of 11, Hatton Garden, E.C., have sent us a useful scale and ruler.

The International Electrical Engineering Co., of Clun House, W.C., has issued an illustrated pamphlet describing the central electric light station at Ploesci, in Roumania, for which it supplied the whole of the plant.

The Christensen Engineering Co., of Milwaukee, have placed before us copies of their lists, as follows:—(1) "Straight air-brake equipments for electric railway cars;" (2) "Christensen air brakes," giving a description of the works where made, and a list of the chief places where they are used; (3) "Ceco" electrical machinery, describing their direct current motors and generators, also their alternators and transformers. The lists are all got up in good style and are well illustrated.

Lists of the "Mallett" steam separator have been sent to us by Messrs. Field, Mallett & Co., Ltd., of 38, Mincing Lane, E.C.

Messrs. Geipel & Lange have issued a new circular, showing and describing their Vulcan portable micro-ohmmeter for rapid and accurate measurement of conductivity.

A new illustrated price list has been brought out by Gebruder Adt-Aktiengesellschaft, of Ensheim, dealing with their electric conduits and fittings for wiring, also tools and appliances for carrying out work of the kind. The list is excellently arranged, well printed and fully illustrated. It is in German.

An interesting illustrated pamphlet has been issued by the Lahmeyer Electrical Co., Ltd., giving particulars of direct-coupled machines for two-system supply.

We have received from Messrs. Blumann & Stern, Ltd., of Deptford, one of their calenders for 1903. At the back of each tear-off slip is a description of their various machine and other oils.

Körting Gas Engines.—We recently announced that Messrs. Mather & Platt, Ltd., had undertaken the manufacture in this country of the Körting two-cycle double-acting gas engine for large powers. We have now received from them a pamphlet containing a description of the construction and working of this gas engine, and giving particulars of the various standard sizes which they are manufacturing. The two Körting gas engines which have been at work since May last at the Düsseldorf Exhibition have attracted the attention of large power users from all countries, and have won the favourable comments of engineers generally. Messrs. Körting and their licensees have already received a number of orders for gas engines of 500 to 2,000 B.H.P., aggregating 53,000 B.H.P., including five engines ordered by Messrs. Mather & Platt for large power users in Great Britain. In view of the great interest which engineers are giving to this subject of large gas engines at present, we anticipate that this pamphlet will be largely in demand.

Three-Phase Electrical Equipment in a Rhondda Colliery.—The United National Colliery Co., at Wattstown, have placed an order with Messrs. D. Bruce Peebles & Co. for an electric pumping and hauling equipment for their pit. The installation will comprise one 100-H.P. three-throw direct-driven pump for raising water from the pit bottom to the surface, and one 150-H.P. hauling gear capable of drawing 40 loaded trams from the face of the workings to the pit bottom, a distance of about 2,000 yards. The motors will be of the Bruce Peebles three-phase type, 2,000 volts, 25 periods. The haulage is main and tail, and the hauling motors will accordingly be fitted with the firm's patent starting and reversing switch, which is specially designed for this class of work. The electric power is to be taken from the mains of the South Wales Electrical Power Distribution Co., who are now commencing to run their Rhondda mains from Pontypridd to Wattstown in the one valley, and to Llwynpia in the other valley. Messrs. Bruce Peebles are providing cables down to the pit bottom large enough to carry 1,000 H.P., as the colliery company intend later on to convert the whole of their plant to electric driving.

American Electrical Shipment.—The value of the exports of electrical plant and apparatus of all kinds from the United States during August last is returned at £164,210, as compared with £181,679 in the corresponding month of last year.

Books Received.—"Papers and Reports Relating to Minerals and Mining." Wellington, N.Z.: By authority. 1902.

"Fowler's Mechanical Engineer's Pocket Book for 1903." Manchester: The Scientific Publishing Co. 1s. 6d. net., and 2s. 6d.

Installation Work.—Mr. E. M. Evans has recently fitted up the St. Oswald's Parish Church, Oswestry, with an installation of 186 lights. This is the fifth church in Oswestry for which he has been responsible. The firm's Manchester house is just completing an installation of over 700 lights at the New St. Mary's Hospital, Manchester.

Correction.—The European Weston Electrical Instrument Co., m.b.H., of Berlin, writes to us as follows:—"In your issue of September 5th, 1902, p. 385, you mention that we have appointed Mr. P. A. Meyer as liquidator. This is an error, inasmuch as Mr. Meyer has received *procura*, and the company does not think of liquidation."

For Sale.—Messrs. P. Huddleston & Co. will sell by auction on November 17th at 93 and 96, Railway Arches, Dalling Road, Hammersmith, a quantity of electrical apparatus, including dynamos and motors, also lathes, machine tools, &c. See our advertisement pages this week.

Trade Announcements.—Messrs. Walmsley Bros., of Empress Chambers, Blackpool, have commenced business as electrical engineers and contractors. They ask for trade catalogues. Mr. A. L. Walmsley, we learn, has had considerable experience in manufacturing, central station and installation work. Private plants will be one of the firm's strong points.

Messrs. Rhodes & Webster, of City Electrical Works, Bradford, inform us that they will in future carry on their business under the style of the "Rhodes Electrical Manufacturing Co." The head office, which will deal with all business inquiries, will be at 70 and 71, Bishopsgate Street Within, London, E.C. This firm are the manufacturers of the R.E. type semi and totally-enclosed motors, with which they have already had great success, including amongst their recent orders several large Corporation contracts and some of the largest trade users. Under the new arrangement, they are extending their works considerably and laying down additional new and modern labour-saving tools in order to meet the increasing demand for their motors. The partners in the concern are A. L. Rhodes, S. W. England, S. H. Fielden, and J. A. Halford. We have received a copy of a new illustrated pamphlet detailing the special points in the R.E. motor.

ELECTRIC LIGHT AND POWER NOTES.

Antrim.—The Council has appointed a special committee to investigate and report upon how far the county is covered by electric supply companies, and to inquire as to what facilities exist for generating electricity by water-power.

Arbroath.—The British Schuckert Electric Co. have just completed a large contract for the complete electric driving of the flax and spinning mills of Messrs. Andrew Lowson, Ltd.

Barking.—In order to minimise breakdowns in the main feeder cables, the U.D.C. has decided to expend £250 in providing feeder pillars where feeders join the distributing mains.

Barnstable.—The T.C. has decided to light the corners of the principal streets with nine arc lamps, and the rest of the town with electric incandescent lamps. It is estimated that energy will be supplied at less than the original estimate of 3d. per unit.

Bermondsey.—The Corporation is applying for a prov. order for extension of its area of supply.

Bexley.—The first instalment of the electric plant for lighting and motive power purposes has arrived at the Corporation's works in New Ing Fields. The plant consists of two Bellis and Morcom engines, and three boilers by Messrs. Clayton, of Leeds. Mr. S. Jones, A.M.I.C.E., who has been engaged in similar work under the Doncaster Corporation, is superintending the fixing of the machinery. The buildings are now practically completed. It is not anticipated, however, that the Corporation will be in a position to supply energy until the new year.

Birkenhead.—The Electricity Committee reports that during the quarter ended September last, the consumption was 73,989 B.T. units, an increase of 23,370 units over the corresponding quarter last year, and the number of consumers was 415, an increase of 101 on the year.

Brighton.—The Board of Guardians has decided to light the old infirmary, the quarantine wards, and two other wards by electricity in place of gas, and Mr. Coote is to prepare specifications at a remuneration of 5 per cent. on the contract. The installation in the main building has resulted in a saving of £51 18s. 2d. per annum, and on the same basis, it is estimated that the new installation will effect a saving of another £60 a year.

Bristol.—A satisfactory account was given of the progress of business at the City Electrical Works in the course of a Local Government Board inquiry on Tuesday. Mr. Pottinger had come down from that department to inquire into an application for the sanction of certain loans, and among them a sum for electrical extensions. Mr. Wise, from the Town Clerk's Office, explained that the demand for power for lighting was increasing at the rate of 400 KW. per annum, and notwithstanding recent extensions, in the course of 12 months they would be using all their plant to meet the maximum load, and would have no reserve available for such an emergency as a breakdown. They therefore proposed to extend in such a way as to carry them on until 1905. These extensions would be at their works at Avonbank. £11,255 would be absorbed by foundations, £9,544 for superstructure, and it was proposed that these two amounts should be sanctioned for a 30 years' loan. For plant £42,400 was required, to be repaid in 25 years. This did not include provision for the contemplated extension of public lighting, for which it was proposed to borrow later on. Mr. Faraday Proctor informed the Inspector that the increase in business was greater than at any previous time. Alderman Pearson, the chairman of the Civic Electrical Committee, entered his "usual protest" against the shortness of the period of loans the Local Government Board fixed for Bristol. Longer periods were sanctioned in London and in

the provinces, while in Scotland the terms were even better than London obtained. The result of these differences was that some works got the credit of exceedingly good management, while others with shorter periods necessarily appeared from their figures to be badly managed. The Inspector said he would visit the Avonbank Works before reporting.

Brussels.—The central power station of St. Gilles, the contract for the construction and installation of which was given to the Boty Co., comprises two de Nœyer boilers of 250 sq. metres heating surface with Worthington pumps, and Desrumeaux purifiers, working at a pressure of 10 kilogrammes per sq. cm., and capable of evaporating normally 2,000 kilogrammes of water per hour; a Zschocke cooling tower; two steam engines on the Walschaerts system, of 225 H.P., each direct coupled to a dynamo of 158 KW. made by the Union Elektricitäts Gesellschaft, of Berlin. There is a Tudor battery comprising 270 cells. The system, three-wire 440 volts, comprises five distributing centres.

Cauvery Falls.—Under the heading "The Cauvery Conceit," *Indian Engineering* says:—"Captain de Lotbiniere has gone to negotiate with the leading electric companies in England and America for working the Cauvery power on a contract for three years from June, 1903. Should he fail to obtain fair terms, he is authorised to engage a number of operators and experts for a fixed period. He will also negotiate terms for a second installation of power."

Chorley.—The T.C. on October 30th received a letter from the Lancashire Electric Power Co., of Manchester, stating that they would be unable to supply the town with power, as the route from Swinton to Rossendale Valley would be nine miles from Chorley, unless a sufficient demand for current arose on the route to the borough. After considering this communication the Council decided to instal electricity works in conjunction with the new refuse destructor which is being constructed, and to ask the B. of T. to further extend the time in which the E.L. order is to be carried out for another year.

Coventry.—Councillor Johnson, vice-chairman of the Estates and Finance Committee, in presenting the half-yearly estimates last week referred to the electric light undertaking. He mentioned that the deficiency on the electric light was only £291, as against £493 in the corresponding half of last year, and he thought that at last the undertaking was reaching that "corner" which would lead to profits for the relief of the rates in future.

Croydon.—The Corporation has decided to spend £45,000 in extensions of plant. The main items in this expenditure are:—Two water-tube boilers, with pipe work and valves, £3,500; mechanical stokers, £850; engine and dynamo (600-KW. set), £7,000; switchboard, cables, &c., £300; condensing plant, £1,200; surface condenser and circulating pumps, £5,181; new mains, £19,810; and the balance for the necessary buildings.

Shortly after 8.15 p.m. on Friday last, a fire was discovered in the electricity works test room, which is situated close to the switchboard of the alternating current system. This was extinguished by means of buckets of sand; a few minutes later, however, the cables under the switchboard were found all ablaze. An attempt was made to extinguish this by sand also, but the inflammable nature of the insulation caused the fire to develop so quickly that the machinery had to be shut down, and the water-hose played on this end of the engine room. Although every cable in connection with this supply was ruined, new cables supplied by Messrs. Callender's were run and coupled up, and the supply was resumed in about 24 hours after the fire. It had been decided to overhaul this cable chamber next spring, it being found impossible to do so sooner. Quite recently the change-over of the centre of the town to direct current has been carried out, and neither this nor the traction supply was interfered with. By the time the Brigade arrived, the fire had already been got under by the works staff, who did extremely well under the trying circumstances, the whole place being filled with dense fumes of burning rubber and bitumen.

Dewsbury.—The L.G.B. has sanctioned the application of the T.C. to borrow £10,000 for the extension of the electricity works.

Dodworth.—The U.D.C. has authorised the clerk to make inquiries with a view to ascertaining the cost of putting down an electric lighting plant.

Drayton-in-Hales.—The Market Drayton Electric Light and Power Co., Ltd., is applying for a prov. order.

Dunblane.—The 1900 electric lighting order has been revoked.

Gorton.—The U.D.C. on October 29th decided to ask Manchester Corporation to submit in writing the best terms upon which it would be prepared to supply the Gorton District with electricity for lighting and power purposes.

Hampstead.—The Lighting Committee of the B.C. recommends that further mains for the supply of electric energy be laid down at an estimated cost of £423.

Falkirk.—On 28th ult. the members of the T.C., on the invitation of Bailie Fairlie, convener of the Electric Lighting Committee, visited the new electric light station at Parkfoot, and were shown over the buildings by Mr. McMillan, the engineer, and others. The works are in a forward condition, and it is expected that the light will be turned on about the beginning of the year.

Hendon.—A special committee of the Council has had an interview with Mr. Pelham, assistant secretary of the B. of T., and reported that the Council under the terms of its provisional order could not transfer the order to any company, no transfer clause having been allowed in the order. It was suggested that application should be made to the B. of T. for an amending order, giving extended time under the Council's present order and authorising the Council to transfer its powers to a company for a given period, reserving the right to take over the working of the order at the expiration of such period upon agreed terms. The Council has resolved to act upon this suggestion, it being understood, in connection with such transfer, that the Council should not be placed under any obligation to raise any loan in connection with the undertaking.

Hertford.—The T.C. on October 30th decided to light the markets by electricity.

India.—Mr. Molesworth, who was consulted on the feasibility of lighting with electricity the towns of Ootacamund, Coonoor, and the Cantonment of Wellington, has submitted his report. He is of opinion that the water-power available at the junction of the Coonoor and Karlari rivers is more than sufficient to generate the required power, not only to light the three towns, but also to work the Nilgiri Railway. The Municipal Council has decided to forward the report to the Government, and to ask it to ascertain from the railway authorities whether they are prepared to work their line by electricity.

Inverness.—At a meeting of the E.L. Committee on 30th ult. the town clerk stated that he had received an application from a London electric lighting company stating that they intended applying for Parliamentary powers to introduce the electric light. The Committee stated that it was negotiating with the Canal Commissioners as to obtaining water-power from the Caledonian Canal for the carrying out of the T.C.'s prov. order.

Ipswich.—A L.G.B. inquiry into the application of the T.C. for loans of £69,900 for electrical energy purposes, and £7,900 for the provision of a refuse destructor, was held on October 29th. The town clerk stated that at present no street lighting by electricity was intended, but it was thought that the installation might bring new industries to the town. There was no opposition. The destructor in this case, as in many others where the Meldrum type is selected, is to be used to supply power at the electricity station.

Isle of Wight.—At the meeting of the R.D.C. on October 30th it was recommended that steps should be taken under the E.L. Clauses Act to control the supply of electricity within the whole of the Council's district. It was stated by the clerk that it would cost about £100 to obtain a prov. order as recommended, and the Council decided to refer the matter back to a special Committee for further consideration.

Italy.—A large pig-iron making plant has just been completed at Portoferraio, on the Island of Elba, to utilise the iron ore mined in the island. The plant comprises a large central power station, which provides the current for the lighting of the works, the operation of the lifts, cranes, &c. The generating plant consists of a Tosi 350-H.P. steam engine connected to a 200-KW. dynamo, and three 200-H.P. gas engines, each driving a 100-KW. dynamo.

Keighley.—The report on the Corporation electricity works for the year ended June 30th last, shows a loss on the year of £2,519, bringing the total loss since the commencement to £4,058. The capital account shows a total expenditure of £46,471. It should be stated, however, that rents, rates and taxes swallowed up £318, or about 22·6 % of the total revenue—a sum which the engineer regards as an unusual burden on the first year's working of an undertaking which has at present so small a revenue. The consumers on June 30th numbered 92, the public lamps 72, and the motors 12 (equal to 64 H.P.). During the year 139,425 units of electricity were generated, and of these 51,194 were sold to private consumers, and 39,543 for public lighting; 32,510 were used in works, and 16,178 units were used in distribution. The present machinery is capable of supplying three times the maximum demand of last year. The cost per unit for coal has been 73d., and for oil and water, &c., 08d. This the engineer thinks will compare favourably with any station of this output in the country. "The prices charged for electricity," proceeds the report, "are too low to make the undertaking self-supporting until the output is considerably increased; but I don't think there would be much demand at any higher rates. At the same time, it is evident that it will be unwise at present to reduce the rates further, either for lighting or power, until it is seen how the undertaking promises to develop. The argument that reduced rates lead to increased demand, and therefore to more profits, does not hold good beyond a certain limit." The engineer estimates the output for the current year at about 180,000 units, and judging from the increase in the demand in the current year, he thinks that the undertaking may become self-supporting at the end of the fourth year of working, or sooner if the tramways should require power next year. The present

plant is equal to producing 400,000 units per annum, and the engineer estimates that that amount would have to be generated per year to make the works self-supporting.

Kingston-on-Thames.—There was a long discussion at the last Council meeting on the deferred question of appointing an expert to investigate the affairs of the electricity supply undertaking. The matter was re-opened because of a letter received from the Kingston Municipal Society, and the end of the debate was the passing of a resolution referring the Society to the previous decision to adjourn the consideration of the question for six months.

Leicester.—An explosion took place on Saturday in a Corporation transformer chamber at the corner of Granby Street and Rutland Street.

Leigh.—The T.C. on October 30th decided to promote a Bill for powers to supply electricity and to construct tramways.

Leyton.—It is stated that the D.C. has made a profit of over £700 on its electric lighting supply during the past six months.

Longton.—The T.C. has adhered to its decision not to supply electricity to manufacturers outside the present area of supply unless a guarantee is given to take 20,000 units per year at 2½d. per unit.

Maesteg.—The U.D.C. intends to apply to the B. of T. for an electric lighting prov. order.

Maidstone.—The E.L. Committee recommends that the supply of electrical energy to factories be at the following rates:—Provided that not less than 50 units per week, per kilowatt demanded, be used, 1d. per unit, and not less than 20 units, 1½d. For motors not coming within the above, 2d. per unit. Subject to the sliding scale at present in use.

Manchester.—The City Council last week considered a proposal of the Electricity Committee that they should be empowered to borrow £10,000 for the purchase of motors, &c., to be let out on hire. The Committee's object was to accommodate the large number of manufacturers who are desirous of employing electricity as a motive power in place of steam. They hoped to supply a demand, and also to stimulate it. The scheme, however, was opposed by the chairman of the Gas Committee (Alderman Gibson), and after a long discussion was rejected in favour of an amendment that the application should be deferred until a full report had been presented to the Council as to the financial position of the Electricity Department. There voted for the amendment 42 members, against it 23.

Maritzburg.—The Electric Lighting Committee of the Borough Council recommended that an additional two miles of low tension cable be ordered, at an estimated cost of £840, and, after some discussion, the recommendation was adopted.

Melbourne.—The transference of the electric lighting system of Melbourne from the Electric Lighting and Traction Co. of Australia, Ltd., to the City Council has now been practically completed. The chairman of the Electric Supply Committee of the Council gave an encouraging approximate estimate of the revenue and expenditure of the undertaking. For the present year, dating March 1st last to February 28th next, the expenditure will be about £44,000 for distribution, maintenance, &c., £12,200 in interest, and £9,800 will have to be provided for sinking fund at the rate of 3 per cent. on £300,000 capital cost, a total expenditure of £66,000. The receipts he estimated would amount to just about the same sum, consequently the Committee expected the concern to pay its way from the first. The £66,000 expenditure included, however, £5,300 profit for the past six months, which went to the company. Thus there was a reasonable hope, says the *Sydney Daily Telegraph*, that the Council would benefit to a considerable extent financially as well as in other directions.

Newport.—The Electricity Committee of the Corporation is about to recommend a new scale of charges for current used for lighting purposes. The revised scale will be as follows:—50,000 units and upwards per annum, 2d. per unit; 30,000, 2½d.; 20,000, 3d.; 12,000, 3½d.; 8,000, 4d.

Newquay.—The U.D.C. has passed a resolution inviting a firm of electricians to consider the lighting of the town by electricity.

North Wales.—"The Utility of Electric Energy in Wales" was the subject of a lecture delivered by Sir W. H. Preece in Liverpool, at the inaugural meeting of the Welsh National Society on Friday evening last. In the course of his remarks the lecturer said that there was nothing so safe as electricity when it was properly managed, and that there was no place where electricity was used to a greater extent and produced cheaper than in Liverpool. In South Wales they were building a generating station worked by steam to produce 75,000 H.P., but he did not think that in North Wales there was more than 20,000 H.P. used. Yet he felt certain that in North Wales, with the waterfalls existing, they could get a central station—he thought the best place would be Carnarvon—from which it would be possible to transmit electrical energy to every part of Carnarvonshire. In South Wales they had contemplated eight large stations. If they were to build a big station and utilise the power which they could get from the falling water in the Snowdonian Range, it was perfectly possible to supply the power at ½d. per unit, and equally possible to deliver it all over North Wales at 1d. per unit. They must get some support for these applications of electricity which were now lying at their doors waiting to be taken up, restricted by want of knowledge, but not restricted by want of capital.

Norwich.—The Corporation Electricity Committee intends shortly to make application for sanction to raise another loan (£10,000) for further extensions of the electric light undertaking.

Penrith.—The U.D.C. is considering a scheme for the electric lighting of the town. The minimum cost is put at £18,000, and it is proposed to purchase a corn mill at Southwaite Green, and to utilise the water of the River Eamont.

Peterborough.—The T.C. has received from the L.G.B. permission to raise a loan of £13,900 for electricity supply purposes, repayable in 25 years. The Council applied for £14,000, but the L.G.B. deducted £100 proposed to be paid to the electrical engineer in respect of the works.

Saxony.—The Helios Electricitäts-Aktien Gesellschaft, of Cologne, has decided to erect an electric power station at Crottorf, in Saxony, for the supply of light and power to the surrounding country. Water power derived from the falls of the Bode is to be used for driving the dynamos, and the power station equipment comprises three hydraulic turbines of about 185 H.P. each; the three geared together to a common axle driving a three-phase alternator. A compound horizontal steam engine of 250 H.P. will take the place of the turbines when the supply of water is inadequate for their efficient working; and a 500-H.P. steam engine direct-coupled to another alternator. The pressure is 7,000 volts. In the more important villages to which the company intend supplying energy, sub-stations are to be erected.

Southampton.—The T.C. has applied for sanction to borrow an additional £4,315 for expenditure in connection with the new generating station at Western Shore.

Walthamstow.—The electrical engineer reports the total number of 8-C.P. lamps applied for as equal to 25,116. Mr. Enright, the engineer, has been instructed by the Committee to urge Messrs. Dowson to fix the new gas plant as soon as possible, and to inform them that the Council will enforce the payment of the penalties under the contract if the work is not completed in accordance therewith. In future all consumers using more than 4,000 units per quarter are to be granted a discount of ¼d. per unit, on payment within 14 days after receipt of their accounts, and the present discount of 5 per cent. and 7½ per cent. allowed to consumers paying 4½d. per unit is in future only to be allowed to such consumers.

Windermere.—The U.D.C. has agreed, jointly with the Bowness U.D.C., to engage an expert to inspect and report as to the lighting of the town by electricity.

Worthing.—The Corporation has received the L.G.B.'s sanction to borrow £8,846 for electric lighting purposes.

Wrexham.—A L.G.B. inquiry is to be held *re* the Council's application for a new loan of £11,000 for the purpose of extending the electricity works.

Malvern.—The chairman of the Lighting Committee reports that tenders have been received for the various things required in connection with the supply of electric light in the district. These showed that the total cost of the undertaking would be something like £14,000 instead of £17,000, the original estimate.

Swinton and Pendlebury.—The B. of T. has consented to an extension of time until October next for the U.D.C. to carry out the prov. order for supplying electricity.

Milton-next-Sittingbourne.—The Kent Electrical Power Distribution Co., Ltd., has asked the U.D.C. to consent to its application for a prov. order.

Portsmouth.—At the meeting of the T.C. on October 29th the E.L. Committee reported that the profit on the undertaking this year was £4,300, and that the expenses of management had been reduced from nearly 1½d. per unit to ¾d.

The T.C. proposes to apply to the L.G.B. for a loan of £17,100 for extensions of plant. This is necessary, owing to the installation to be made in the New Naval Barracks, which will produce an estimated revenue of £5,000 per annum.

Holland.—The Communal Council of Oude Pekela has withdrawn the concession awarded some time ago to the Eerste Nederlandsche Electr Maatschaffij, and confiscated its deposit. A new adjudication will, therefore, probably be announced shortly.

Moulton.—The Parish Council has decided to ascertain the cost of lighting the village by electricity.

(Continued on page 789.)

THE ELECTRIC LIGHTING OF SWORDALE.

In our recent "Power Number" we remarked that the number of water-power electric installations in this country is probably much larger than is generally supposed, and we are this week able to give a description of one not hitherto described, which possesses several points of interest. We refer to that at Swordale, near Evanton in Ross-shire, the residence of Mrs. Randle Jackson.

View Showing Pipe-Line.

The house is a large one, standing in a fine estate, part of which is on the slopes of Ben Wyvis. A steep hill rises behind the house, from which magnificent views of the Cromarty Firth, Glen Glass, and Ben Wyvis, the "Giant of the North," can be obtained, and below the ground slopes rapidly to the River Skiack, from which the power is obtained.

The Skiack is a river some 12 miles long and draining about 15 square miles of country—some of the land drained is nearly 3,000 ft. above sea level. The river is a rapid one, and passes through no lakes which would serve to regulate the flow; when therefore it rains heavily on Ben Wyvis, or when the winter snows melt, the water comes down in huge spates, and has been known to rise and fall some 8 ft. in the course of a day. During the dry weather the flow is mainly kept up by springs which abound on the hills.

The Main Fall.

About 300 yards from the house is a fine waterfall with an almost perpendicular drop of 15 ft., and with rapids above and below. Some 10 ft. in the fall of the rapids have been utilised, and thus the total head is 25 ft.

About 100 ft. above the main fall a massive concrete dam has been thrown right across the stream, and at one end of this, close in shore, a strainer pit has been constructed. On the right bank the dam is built into rock, but on the left bank it had to be carried well into a bed of boulder gravel. The footing of the dam in the river is solid bed rock throughout.

Inside the strainer pit is the usual pentrough and zinc strainer, and closing the entrance to the pipes is a sluice suspended by stout steel rope, and raised and lowered by winch and handle. The entrance to the strainer pit is guarded by a grating of iron bars, to exclude roots of trees and the great branches which are often brought down in floods.

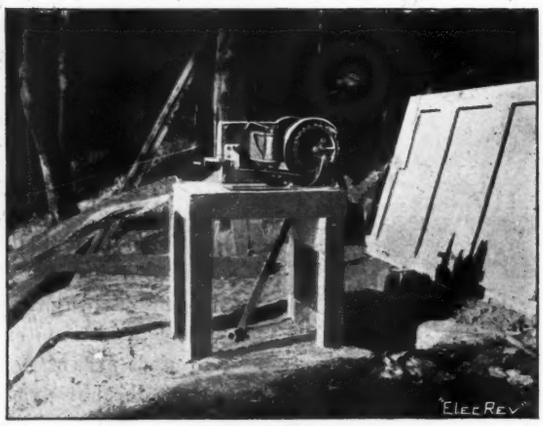
The pipes used are 20-in. riveted steel throughout, and for the first 100 ft. after leaving the strainer pit they run over an almost level shelf of rock of the hardest whinstone; afterwards they pass round a difficult rocky bluff, supported on stone and brick piers, thence into a short trench, and finally along an embankment into the turbine house. The total length of the pipe is about 400 ft.

The turbine house is a simple square building, with accommodation for two generating sets. The tail pit is 10 ft. deep, and is solidly constructed of Portland cement and stone obtained from the excavation of the foundations and tail race, the ground being boulder gravel full of great granite and whinstone boulders, brought to their present position during the "Great Ice Age," when the valleys around Ben Wyvis were filled with immense glaciers. The tail race is 50 ft. long, and after passing under the turbine house is open.

"Swordale."

The plant at present fixed consists of a Mavor & Coulson dynamo coupled direct to a Gilkes "Double Trent" turbine, running at 500 revolutions per minute. The output at full load is 70 amperes at 140 volts. The oiling arrangements

are automatic and continuous, and the whole plant is so arranged that it can be shut down automatically and left until it is necessary to start again. The dynamo is shunt



Automatic Shut-down Device.

and compound wound, so as to either charge batteries or run the load direct. The mains from the turbine house to the house are the British Insulated Wire Co.'s concentric lead-covered and armoured cables, run in a trench to the battery house, where the main switchboard is situated.

The battery is of the Chloride Electrical Storage Co.'s make, consisting of 55 cells of 300 ampere-hours capacity at the 6 hours discharge rate, and all arranged on the same level so that all cells are equally accessible.

One end of the battery house is partitioned off to accommodate the switchboard, which contains battery charge and discharge switches of the parallel type, an automatic Crawley battery switch, and instruments of the dead-beat moving coil type. A reversible Aron battery meter reading direct in ampere-hours and containing Miller's device for automatically adding an extra charge to the battery is fitted, and there is also a special relay for operating the sluice.

A specially interesting feature of the installation is the automatic arrangement for shutting down the whole plant when the battery is fully charged.

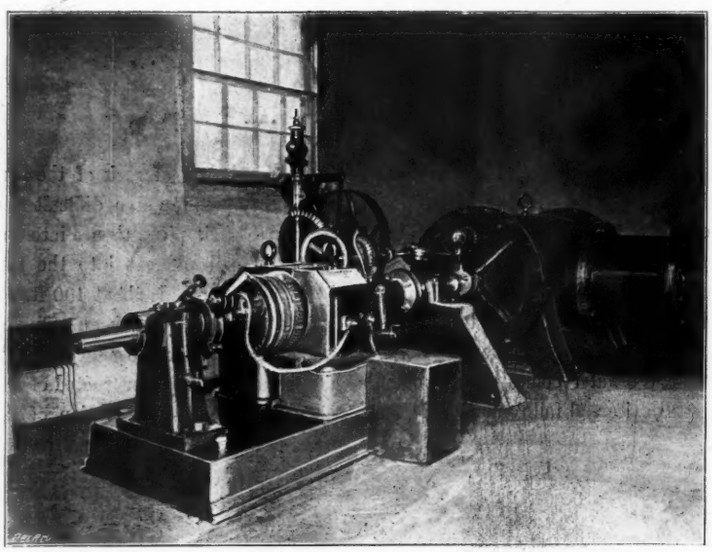
As already stated, the sluice at the head of the pipe line is raised by a steel cable operated by a winch. An electromagnetic device is combined with this winch, so that when the magnet is excited it pulls up an armature with considerable force, striking a toggle joint connected with a detent and thus freeing the winch and allowing the sluice to fall and shut off the water from the pipe line; a counterweight is provided to prevent the heavy cast-iron sluice from falling with too great a shock. A heavy sluice is necessary, as the rush of water would prevent it closing if it had not a considerable momentum.

The magnet on the sluice gear is excited from the dynamo, as shown in the diagram on p. 783, the current being switched on by the relay referred to in the description of the switchboard. The relay is operated by current from two cells of the battery, the circuit being closed by a small attachment to the Aron meter, which makes contact when the pointer indicates that the battery is charged. It will thus be seen that when the battery is full, the sluice falls, the pipes empty themselves through the turbine, and when the dynamo current reaches zero the Crawley switch cuts the battery out.

By means of this arrangement the attendant need only pay one visit a day to the turbine house, and after setting the plant to work he may leave it, to attend to other duties, with the certainty of its shutting down at the proper time. The regulation of the house pressure can be attended to by one of the servants in the house.

This arrangement is, we understand, quite novel and works admirably, and it will be readily appreciated that while originally designed for this water-power installation, it is applicable not only to water-power plant, but also to oil and gas engines, and in isolated installations it should be valuable. It has, we understand, been patented.

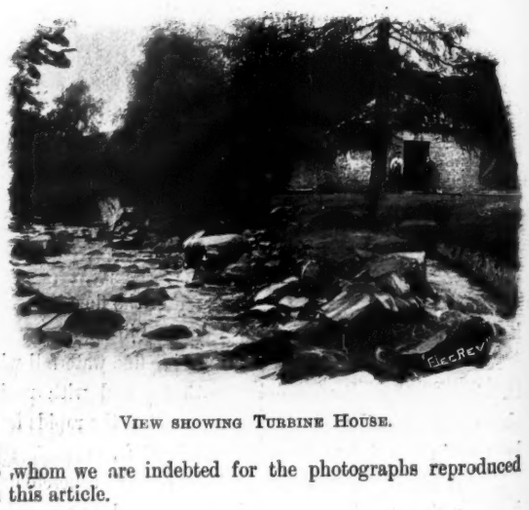
The work in the house has been carried out on the concentric system with lead-covered wires. The fittings are mostly of Messrs. Osler's make. Electric heating is used in the turbine and battery houses, and there is ample power in the fall for an extensive electric heating installation in the house.



"Swordale" Turbine Plant.

Previously to the introduction of electricity, oil lamps were used throughout the house, and as these required cleaning and trimming daily, it will be understood what an immense boon the electric light has proved to residents and servants alike. Not only is it a convenience, but actually a considerable economy, for beyond the use of a small quantity of lubricating oil and the attendant's time for one hour a day, there are absolutely no running costs.

The installation has been in use for over a year; it was designed and supervised by Mr. Walter P. Adams, M.I.E.E., to whom we are indebted for the photographs reproduced in this article.

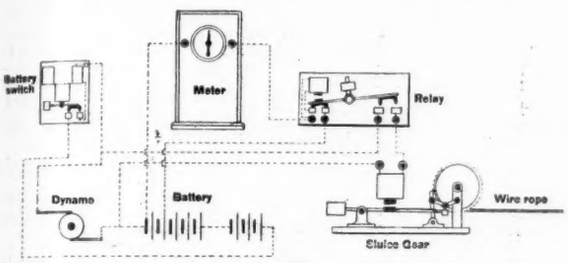


View showing Turbine House.

THE LEEDS ELECTRICITY WORKS EXTENSIONS.

The New Two-phase Plant.

The electricity supply works at Leeds have been in operation since May, 1893, from which date up to December,



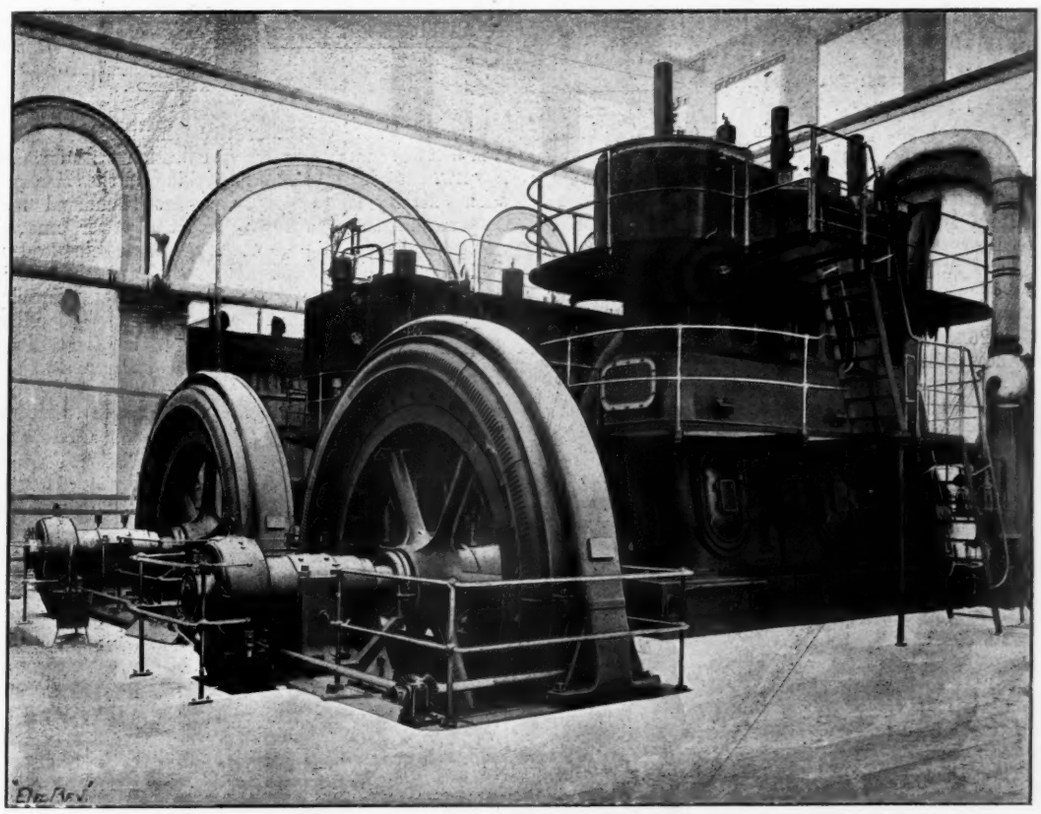
Swordale: Diagram of Automatic Shut-Down Device.

1898, they were under the control of the Yorkshire House-to-House Co. When the Corporation effected the purchase, its favour. It is contemplated that gradually a number of the existing single-phase alternators will be converted to two-phase.

The site which the Corporation had available for the new works comprised an area of 290 ft. × 181 ft., and it was decided to build on the whole of this land at once. The buildings consist of engine house, switchroom, cable cellar, boiler house, stores, and workshops. The engine house is 220 ft. long × 65 ft. in width × 33 ft. high from floor line to crane rail.

The switchroom is built with a view to accommodating step-up transformers for feeding the outlying districts of the city at extra high pressure if it should be necessary later on. Underneath the switchroom is a cable cellar, leading to the subway running from the works to Queen Street. This extends the whole length of the switchroom, and forms a ready means of bringing the cables from the dynamos to the switchboard, and taking the circuits away to the different parts of the town. Over the switchroom is the stores, and over the boiler house is placed a coal store, which is capable of holding 4,000 tons of coal, about four weeks' consumption.

The plant installed in the engine room is of British manufacture. It includes one McLaren engine and



Leeds: General View of New Two-Phase Plant.

there were 65,328 lamps (35-watt equivalent) connected to the mains, and the plant capacity was 2,400 kw. Very large extensions were carried out from year to year, and by March last there were 178,422 lamps connected, and the plant capacity was 5,940 kw.

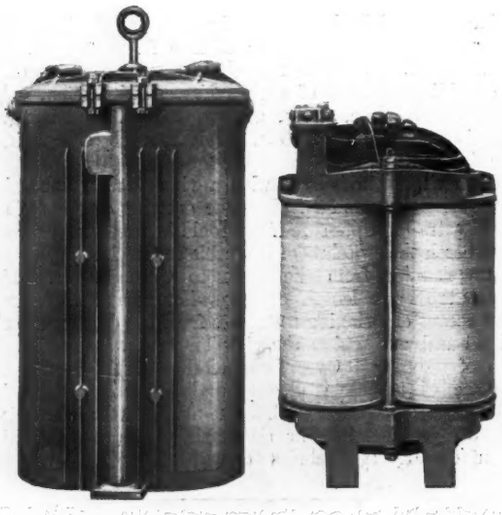
It has recently been found necessary to again enlarge the works, in order to meet the growing demands for power as well as lighting, and it was considered wise policy to carry out an extension which shall be sufficient to provide for some years ahead, thereby enabling larger units and labour-saving apparatus to be put in and reducing the working costs by producing energy on a large scale.

The question of supplying power for motors was very carefully considered by the Committee, and it was decided to put down the new extensions for generating two-phase alternating currents, as this system is very suitable for driving motors. The ease of conversion of an existing single-phase distributing system to two-phase was also a strong point in

one Belliss engine, both coupled to alternators made by the Electric Construction Co. The size of the engines is 2,400 h.p., and the capacity of the dynamos is 1,500 kw. each. The engines are of the triple-expansion enclosed type with forced lubrication. The dimensions of the McLaren engine are as follows :—High pressure cylinder, 27½ in. diameter; intermediate, 39½ in. diameter; low pressure, 64½ in. diameter; stroke, 24 in.; speed, 200 r.p.m. The valves in this engine are Trick-ported slide valves, balanced horizontally and vertically. The space occupied by the engine is 24 ft. × 9 ft. × 20 ft. high, and the floor space occupied by the whole plant, engine and alternator, is 38 ft. × 18 ft.6 in. The governor is of Messrs. McLaren's patent automatic expansion type.

The dimensions of the Belliss engine are :—High pressure cylinder, 22½ in. diameter; intermediate, 35 in. diameter; low pressure, 55 in. diameter; stroke, 2 ft. 6 in.; speed, 200 r.p.m. The valves are of the piston type, and the

governor acts on the throttle. The space occupied is 25 ft. 3 in. × 8 ft. × 22 ft. high, and the floor space

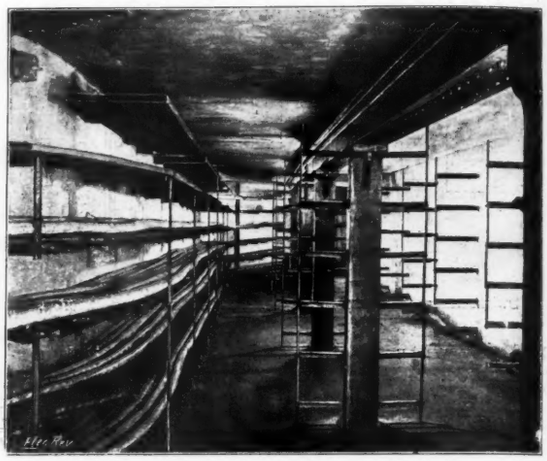


Leeds: Transformers.

occupied by the whole plant, engine and alternator, is 38 ft. × 18 ft. 6 in.

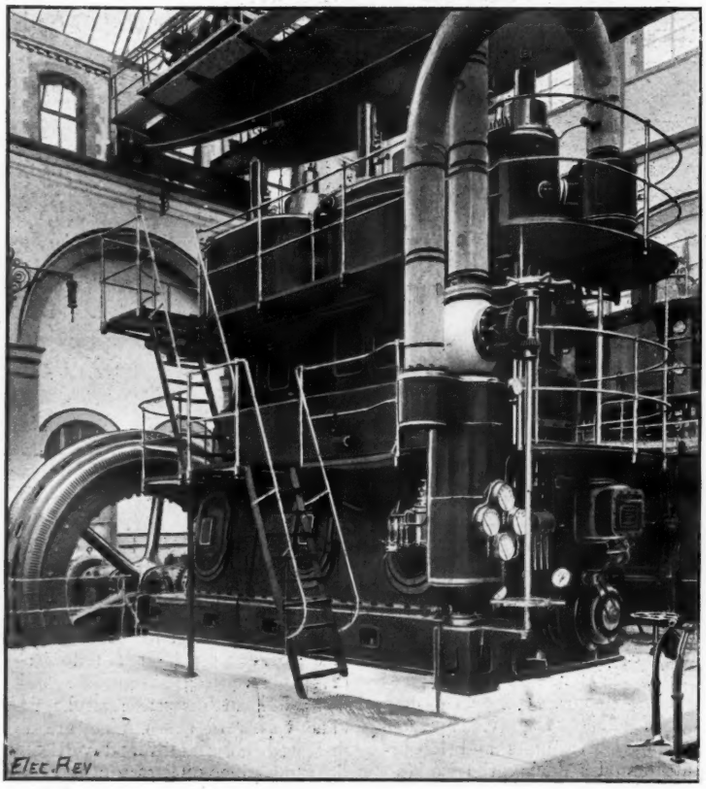
The dynamos are made to supply two-phase current at 50 periods per second, and generate 2,000 volts in each phase. The armature is stationary and the field magnets revolve. The alternator shaft is bolted up direct to the engine coupling, and runs therefore at 200 r.p.m. The diameter over the field magnets is 13 ft. 6 in., and the weight of the magnets and wheel and shaft is 28 tons. The magnet poles are bolted to a cast-steel ring which fits over a cast-steel spider. The armature winding is of the Electric Construction Co.'s usual slot type.

The maximum output is 1,750 kilo-volt-amperes at 2,200 volts on a load having a power factor of ·8, each machine having 30 poles, giving 50 periods per second. The fly-wheel effect is such as to reduce the fluctuation in velocity during a revolution to less than $\frac{1}{20}$th of 1 per cent. from the mean velocity, and the paralleling force is so great that the synchronising current is hardly perceptible. The guaranteed commercial efficiency is 95 per cent. at half load, while, close regulation of voltage being so essential with two-phase machines required to work on a combined motor and lighting load, the specification calls for a maximum drop in voltage from no load to full non-inductive load of 4 per cent., and of 12 per cent. on a load having a power factor of ·8. It is further guaranteed by the contractor that when one phase is carrying full non-inductive load, the other being on open circuit, the difference in the voltages of the two phases will not exceed $3\frac{1}{2}$ per cent.



Cable Subway at Leeds.

The E.C.C. are expecting that the machines will give even better results than the specification calls for, as their 700-kw. two-phase machines, working in the same station, when officially tested by Mr. Robert Hammond for the Corporation, showed a drop of less than 3 per cent., and a voltage difference of $2\frac{3}{4}$ per cent., one phase being loaded and the other on open circuit. The exciter for each machine is mounted on the alternator shaft, and is of 8 kw. capacity.



Leeds: Belliss Engine and E.C.C. Alternator.

In the cellar below the engines are placed two surface condensing plants, made by Messrs. Cole, Marchent and Morley, one condenser for each engine, in connection with which are two centrifugal pumps, made by Messrs. Belliss and Morcom, Ltd. The condensers have 3,400 sq. ft. of heating surface each, and the number of tubes in each condenser is 2,245, of $\frac{3}{4}$-in. internal bore, and 7 ft. 9 in. in length.

The steam, feed, exhaust, suction, and air pump discharge pipes, oil filters, &c., were supplied by Messrs. John Spencer, Ltd., of Wednesbury. The steam pipes are of lap-welded steel, with flanges welded on. The exhaust pipes are wrought-iron, riveted, and the remainder of the pipes are cast-iron. In the exhaust pipe, between the engine and its condenser, is placed a Holden and Brooke's oil separator, for extracting the oil from the exhaust steam before it passes into the condenser.

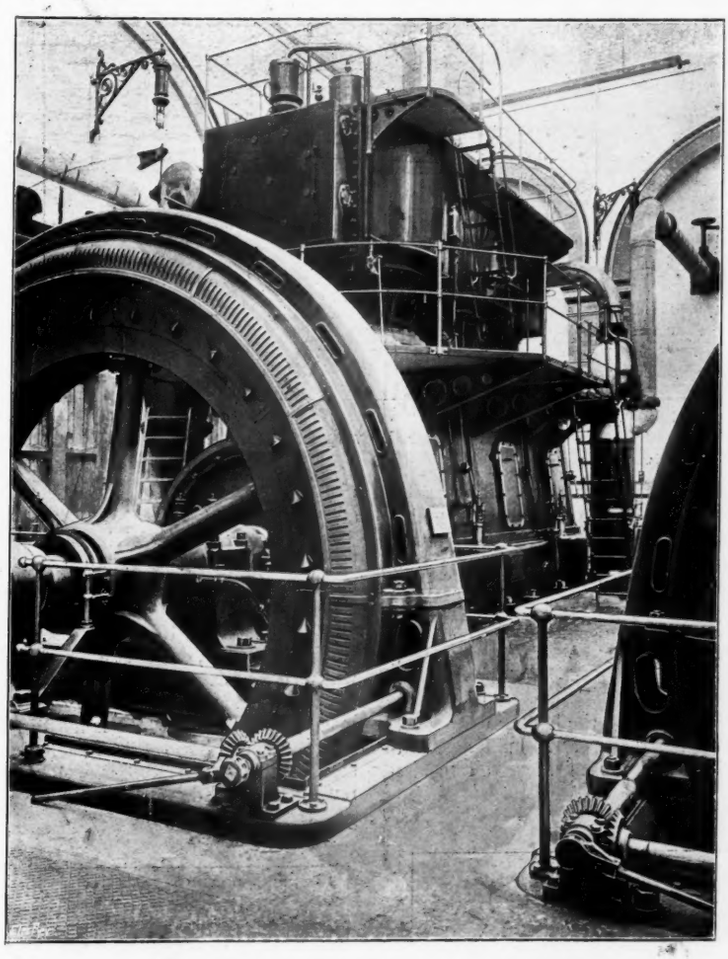
and the discharge water from the air pump for the condensers is passed into the feed tanks placed in the pump house.

There is a 30-ton overhead travelling crane supplied by Messrs. J. Booth & Bros., Ltd., of Rodley. It is equipped with a two-phase motor.

The switchboard was made by Messrs. Ferranti, Ltd., and consists of six sets of their two-phase oil-break switches on the dynamo board, with the necessary bus-bars, synchronising apparatus, &c., and 30 circuit panels of the ordinary spring break type. The apparatus is mounted on a glazed brick wall, the dynamo board being on one side and the circuit board on the other side of the wall. The exciter regulators are placed on a separate table away from the board, with the instruments in the exciting circuit placed on a small board at the back of the controlling table. The new board is coupled up to the existing switchboards by three sets of feeders.

The cable cellar running under the floor of the switchroom is so arranged that the cables leaving the board are carried down direct on to shelves, supported on brackets carried on iron pillars, and the cables then pass away into the cable subway, which runs as far as Queen Street, a distance of 350 yards. By this means it is possible to get at any cable easily and at any time, as there is a space of 2 ft. 6 in. between opposite tiers of shelves through which the attendant can walk. The subway proper is 11 ft. wide × 7 ft. high, with a line of pillars supporting the girders in the roof. The brackets in this subway are fastened into each of the side walls, forming a line of shelves on each side, and there are also brackets placed on the centre columns, one tier of brackets on each side of each pier, thus leaving a walk of 2 ft. 6 in. on either side between the wall brackets and the pier brackets. The subway is capable of holding 200 cables. Outlets are provided at each street crossing for the exit of cables. The whole of the subway is enclosed in waterproof course.

At each of the sub-stations there is a transformer of 60-KW. output, the primary current being supplied at 2,000 volts, 50 periods; the secondaries are wound to give either 205 or 410 volts. These transformers are of the E.C.C. patented type, the special feature being the use of circular stampings, having only one joint, thus giving the lowest possible magnetic resistance for a given coil area. The tests show an open circuit loss of 460 watts, and a guarantee is given that the magnetising watts will not increase after the transformers are put to work, the drop in voltage from no-load to full non-inductive load being just 1 per cent., while on a load having a power factor of ·75 the drop is still under 2 per cent.



Leeds: E.C.C. Alternator and McLaren Engine.

The boiler house is arranged to hold 24 water-tube boilers, with 4,300 sq. ft. of heating surface each. At the present time there are installed eight Babcock & Wilcox water-tube boilers fitted with superheaters and purifiers. The boilers are fitted with Meldrum's coking stoker, and forced draught. They are arranged to be placed 12 on one side of the boiler house, and 12 on the other, with a space of 26 ft. between the fronts of the boilers. Immediately above the boiler house is the coal store, where the coal is stored, and from which it gravitates by means of inclined shoots into the mechanical stokers. There are two shoots to each stoker. The coal, after being placed in the overhead bunker, thus gravitates automatically through the coal shoots into the hopper of the mechanical stoker, and it is then passed through the fires mechanically by means of the moving bars, &c., in the stoker. When burnt, the clinker is thrown off the end of the bars on to an inclined shoot, and the ashes are removed into a cellar under the boiler house floor, where provision is made for slacking them; they are then taken away by means of an ash conveyor, and stored in an overhead bin at the north end of the boiler house until they are removed from the works. An economiser is placed over the boilers, between the coal store and the western wall of the engine house. This economiser is made by Messrs. E. Green and Son, Ltd., and consists of 960 tubes of their standard make; special provision, however, is made to provide for expansion and contraction in this long length. Provision is also made in this boiler house for three other economisers of the same size, one economiser to each set of six boilers. There is only one chimney placed in the centre at the eastern side of the boiler house, the boilers from the west side of the boiler house being connected to the chimney by means of an overhead flue. The line shafting for driving the mechanical stokers and the conveying plant is all driven by means of two-phase motors.

The pump house is situated at the south end of the boiler house and is fitted with two feed tanks; it is capable of holding seven Weir pumps, which would feed the whole 24 boilers. At present there are provided two pumps with a capacity of 4,000 gallons per hour each, and one with a capacity of 8,000 gallons per hour. There are also installed two Worthington pumps, one with a capacity of 12,500 gallons per hour and the other 25,000 gallons per hour. These pumps are used for drawing the water from the river, passing it through a battery of Hawksley Wild & Co.'s filters, and then discharging the water into the overhead storage tank.

The coal conveying plant, not yet erected, is being supplied

by the New Conveyor Co., and consists of elevators and conveyors for the coal and ash conveying plant for the ashes. The coal is brought down to the works in the Corporation's own boats, and is discharged by means of a crane made by Mr. Thomas Smith, of Rodley. This crane is mounted on an elevated structure 15 ft. above the wharf level, and is capable of travelling over a distance of about 60 ft. on this structure. It is fitted with a grab to enable the coal to be handled as quickly as possible. Immediately under the crane rails is placed a plate conveyor, which runs under the whole length of the elevated structure for the crane. The plate conveyor is 3 ft. wide, and fitted immediately above the plate conveyor are sheet-iron sides, placed on an angle to direct the coal when discharged from the grab direct on to the conveyor. The coal is then taken to a hopper immediately outside the boiler house entrance, and is there elevated by means of two conveyors to the coal stores, through which it is transmitted on three pushplate conveyors, one in the middle, and one on either side of the bunkers. The coal can thus be discharged at any point in the stores as required. The plant can deal with 40 tons of coal per hour. From the stores the coal gravitates down the inclined shoots to the mechanical stokers, as explained above. The ash conveyor is of the plate conveyor type, and carries all the ashes to the north end of the boiler house. The ashes are there discharged into a bucket elevator, carried up and discharged into an overhead ash-bin, from which they are released and discharged into carts by means of a shoot at the bottom of the bunker.

The workshops are at the north end of the buildings, and include mechanics', smiths', and joiners' shops, all repairs being done on the premises except in the case of very large work.

Mr. H. Dickinson, the Corporation's electrical engineer, was responsible for the electrical and engineering part of the undertaking, and we are indebted to him for the accompanying photographs of the plant.

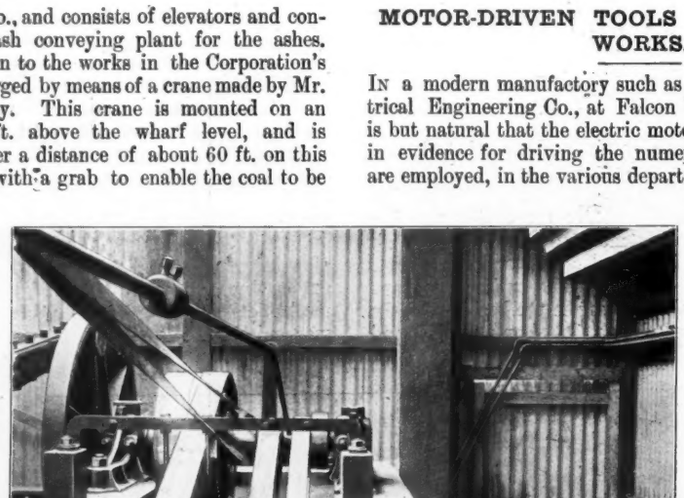


Fig. 1.—Motor Driving Log Saw.

MOTOR-DRIVEN TOOLS AT THE BRUSH WORKS.

In a modern manufactory such as that of the Brush Electrical Engineering Co., at Falcon Works, Loughborough, it is but natural that the electric motor should be very strongly in evidence for driving the numerous machine tools which are employed, in the various departments where car building operations, the manufacture of motors and generators, &c., are in progress. We give herewith illustrations of a number of the specimens to be met with.

Several large horizontal saws are in use, one being a 24 in. × 24 in. with 36 ft. table, driven by belt from a 6-B.H.P. Brush enclosed motor (1,300 r.p.m., 220 volts). This saw is situated between the old log yard and old timber shed. The motor is of a type which is made and stocked by the Brush Co. in 14 different sizes, ranging from ½ to 50 B.H.P., and it is specially designed for factory and machine tool driving. It can be open, semi, or totally enclosed at will.

Another saw, whose driving arrangement we show in fig. 1, is a 48 in. × 48 in. with a 40 ft. table, and it is driven by a belt from a 15-H.P. Universal motor running at 1,100 revolutions. This saw is placed between the new log yard and the new timber store. Large logs are passed from the log yard through this saw, cut up, and passed into the timber stores, where they remain until they are well seasoned.

Fig. 2 shows a four-pole enclosed motor, driving a magnetic separator, which is fixed in the stores department, where all metal borings are sent for separation from iron or steel borings. The motor is of 1 B.H.P. (220 volts at 1,300 revolutions) and drives by belting.

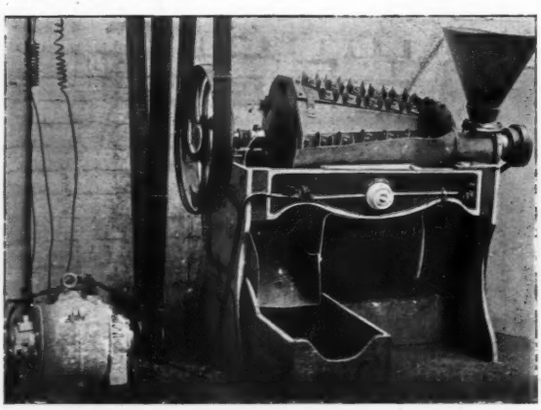


Fig. 2.—Magnetic Separator.

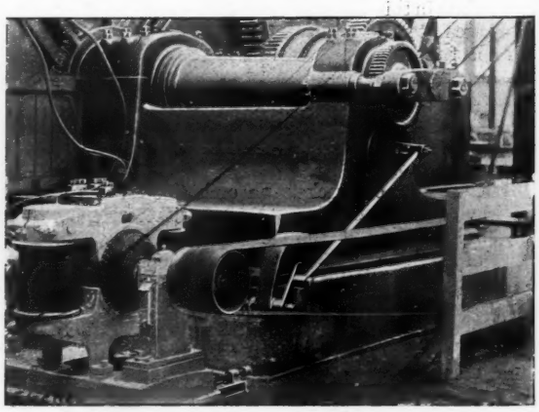


Fig. 4.—Motor-Driven Lathe.

A 15 B.H.P. Brush Universal two-pole motor drives a large horizontal drill 12 ft. × 10 ft., as shown in fig. 3. This machine is used for drilling stator and magnet castings of large alternators and generators. The motor runs at

1,300 revolutions, and the voltage, as in all other cases, is 220 volts.

Two large 20-ft. face lathes, for turning and boring the rotors and stators of large alternators, are driven by a 25-B.H.P. Universal two-pole motor, running at 860 revolutions. This is shown in fig. 4. The largest motor is of 50 B.H.P. (480 revolutions), of the same type, and it drives (see fig. 5) a 10-ft. × 10-ft. × 20-ft. large planer for planing the underbed and soleplates of large alternators and generators. There is also a 36-B.H.P. similar motor fitted as a stand-by to this large planer, in case the 50-B.H.P. motor should give out. It runs at 1,000 revolutions per minute.

A small planer (8 ft. × 8 ft. × 16 ft.) for planing large castings is run by a 31-B.H.P. motor at 880 revolutions. In fig. 6 a two-pole motor is shown driving a centrifugal pump, which draws water from the canal a mile away through two 12-in. cast-iron pipes, for supplying the testing room and power house with circulating water for condensing and other purposes. The motor is rated at 33 B.H.P., and runs at 550 revolutions to give 2,000 gallons of water per minute.

A two-pole overtype motor drives, through spur gearing, an air pump attached to a portable condenser (fig. 7), used for the purposes of water consumption tests in the test room. The motor gives 8 B.H.P., and its speed is 750 revolutions.

A foundry blower is driven through direct coupling by a two-pole motor, rated at 25 B.H.P., and running at 900 revolutions. A performance of 3,000 cub. ft. per minute is obtained from this blower.

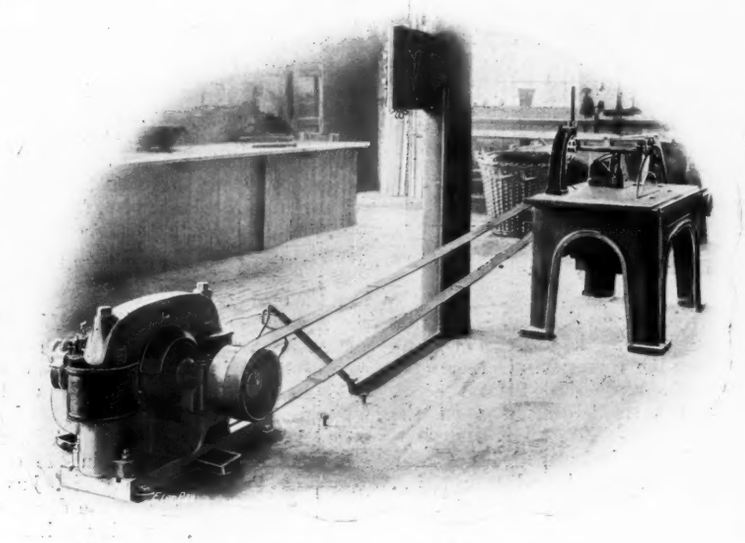


Fig. 8.—Electrically-Driven Circular Saw.

The only other machine that we propose to direct attention to is a 20-in. circular saw (fig. 8) in the packing warehouse. This is driven by an 8-B.H.P. motor (two-pole), running at a speed of 1,500 revolutions per minute.

TRAIN LIGHTING BY ELECTRICITY.

By A RAILWAY OFFICIAL.

The lighting of railway trains by electricity was a subject in which considerable interest was manifested a few years ago, but, whilst there has been some progress in adapting electricity as an illuminant for this purpose, the extent of the progress made is not nearly so great as was at one time anticipated, and may even be said to be somewhat disappointing. There have been, no doubt, many causes contributing to this result.

Electricity, when first tried for the purpose, had but recently attained to the dignity of a branch of engineering, and the apparatus used to give effect to the requirements perhaps left something to be desired. The conditions under which the new illuminant had to be applied were also somewhat onerous, and involved special arrangements of apparatus. It was also soon discovered that traffic requirements prevented distribution throughout a train from one point except in cases where the trains ran *en bloc*. Where trains require to be broken up at different points on the route, it is absolutely imperative that each car should be self-contained if the lighting is to be continuous.

Perhaps, however, the principal cause of the slow progress of train lighting by electricity consisted in the strong position which gas lighting took up about the time when electricity was being experimented with, the great improvement in lighting effected thereby, and the large sums sunk in

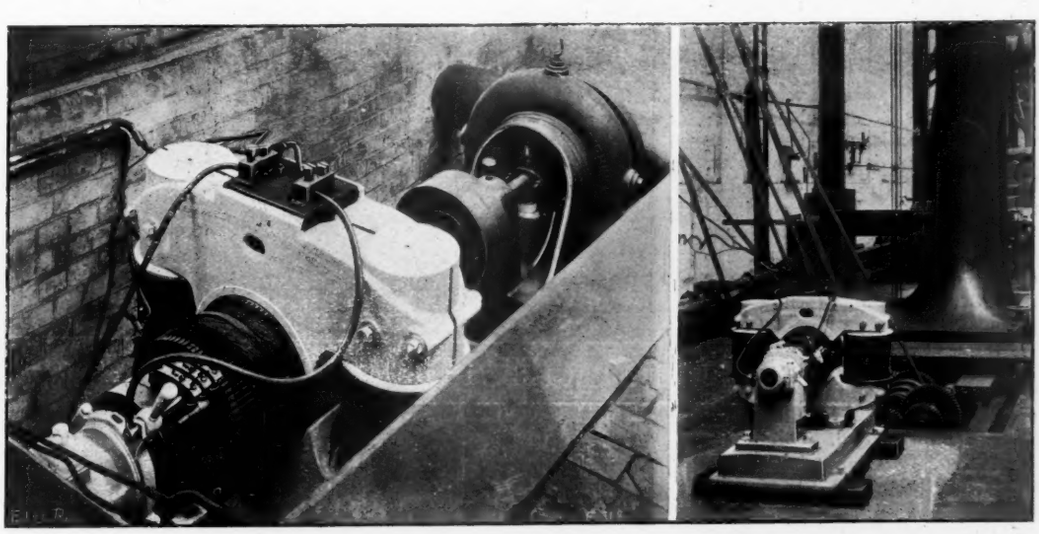


Fig. 6.—Motor-Driven Centrifugal Pump.

Fig. 3.—Electrically-Driven Drill.

installing the plant and equipping the trains. Leaving side issues for the present, it must be confessed that the lighting of railway trains by gas has hitherto been very successful, and that, considered as an illuminant only, changes to elec-

tricity are only likely to be made for sentimental or advertising purposes, so long as our railways are operated as at present. The systems lend themselves admirably to the requirements. Each carriage contains its own supply under

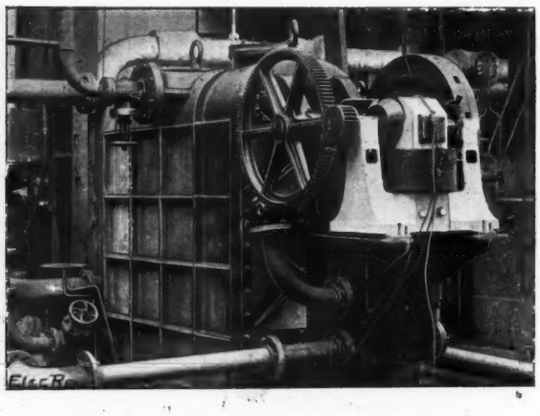


Fig. 7.—Overtype Motor driving Air-Pump.

excellent conditions as to maintenance, the light is as a rule good, steady and well distributed, and the products of combustion do not foul the air in the compartments, the supply of gas can be easily and quickly replenished at stated points, and the system makes but small demand upon the locomotive.

This question of demand upon the locomotive is of some importance, especially in the case of fast long-distance trains. In the case of gas, the illuminant is prepared beforehand, and the demand upon the locomotive is confined to the additional tractive effort required in consequence of the additional weight owing to the carriage of the gas containers, &c. This weight is very small compared with that of the vehicle, and the additional tractive effort, where speed is the most important factor in the power required, becomes microscopic.

On the other hand, with the ordinary arrangement of dynamo and cells for each carriage, the increase in weight may be as great or even greater than with gas, and, in addition, whatever power is absorbed in the mechanical arrangements and in the circuits must necessarily be drawn from the locomotive. The power as absorbed may look small when compared with the total power developed by the engine, and it is undoubtedly so; but when, as often happens, the engine is working to its last ounce, so to speak, the difference counts in the opinion of locomotive engineers. In the continual duel between the locomotive and traffic departments, the latter may be trusted to provide the former with all the work the locomotives can perform. It is not the average road that tells the tale, and strains the coal and water space, and the steaming quality of the boilers: but the gradients which have to be negotiated here and there, and for which the engines have to be carefully nursed.

It is difficult to accurately gauge the effects on the engines. Locomotive engineers are naturally sceptical of the truth of statements which imply that electric light can be obtained in the method ordinarily employed without affecting the performance of the engine for its original purposes. Calculations of the power absorbed in the circuits do not constitute a reliable guide to the full effects experienced. Careful drivers aver that the difference in the "feel" of the train is appreciable, but the true test is the coal consumption under identical conditions. Such statements, however, as "an engine working from Crewe to London burns an additional 14 cwt. of coal if the train is fitted with electric light" are loose, and do not give full details of the comparative tests. This would imply that the extent of use is unimportant, and that all details relating to the trains, speeds, weights, and train resistances, including that due to atmospheric conditions, were all precisely similar. Such conditions, of course, apply equally to the "drag" of the trains which drivers feel. The subject is one on which it is most difficult to do more than theorise, since the total effects upon the locomotive are due to a variety of causes, which are not easily separable, and which are not constant. Such tests as would be required to establish the facts are not common on railways, and the arrangement of precisely similar conditions for comparative tests would be almost an impossibility in ordinary service, and hardly worth the trouble of special arrangement under existing conditions. The fact remains, however, that the necessary power must under the conditions assumed be drawn from the locomotive, that such comparisons as have been made indicate greater effects than would be assumed from theoretical considerations, and that there is, therefore, some amount of prejudice against imposing this extra work on the engine.

A writer in the *Engineering Magazine* for October gives some interesting particulars with regard to train lighting on the Continent, from which we find that lighting by candles is still in use in some parts. Lighting by oil lamps, petroleum oil gas, oil gas enriched with acetylene, and by electricity, are all dealt with. A description of a system of lighting by accumulators in use on the Northern Railway of France is also given, but its value is somewhat marred by errors in the diagram showing the connections of the cells, regulating switches and circuits. There

Fig. 5.—50-h.p. Motor driving Planer.

are 60 cells, arranged in two batteries of 30 cells each, to each carriage, these being carried in special cases attached to the framework. The cells are charged *in situ* before the

departure of the train, from circuits arranged on the platform.

Such a system as this, or that described by the same writer as in use on the Jura-Simplon Railway in Switzerland, where the cells are charged at a central station and distributed as may be necessary from a special distributing car, makes no other demands upon the locomotive than arise from the additional weight imposed, and corresponds more closely, therefore, to the conditions under which gas is applied. The lighting of trains from accumulators ready charged and changed as the exigencies of the service and the capacities of the cells require, has also been experimented with in this country, but the progress has been very small compared with the opportunities. The reasons for this are, probably, not hard to find. The comparatively high price of electrical energy in this country, the duplication of batteries to admit of replacements, the labour cost of such replacements, the time occupied in charging, the deterioration of the cells, and the large amount of capital already sunk in the equipments for lighting by gas, all combine to hinder the progress of lighting trains by electricity.

There is, however, one aspect of the question of lighting trains by gas which should not be neglected. The presence of large quantities of gas on trains which may have suffered disaster is undoubtedly a source of great additional peril to those who may be involved. Railway mishaps are themselves sufficiently formidable, and not infrequently have given rise to fire among the *débris*. If to this is added the liberation of quantities of gas by damage to the containers, the danger of a general conflagration, as an addition to the other horrors of a railway accident, becomes very great indeed. That the containers are, or can be made, sufficiently strong to prevent escape of gas under such conditions is unthinkable. That such occurrences have not as yet taken place may be considered as a testimony to the care exercised by railway companies in the working of their traffic, rather than evidence that the danger is non-existent, or even remote. Changes in the character of train lighting, as in other things, come about as the result of imperative demand, or the presence of facilities for such changes. At present there is no public outcry for better service, such as led to the introduction of gas in place of oil, and the facilities for electric lighting will only come when and as the electrification of railways progresses. Meanwhile the present methods of effecting train lighting by electricity can only be looked upon as stop-gaps.

ELECTRIC LIGHT AND POWER NOTES.

(*Continued from page* 780.)

Swindon.—The T.C. has fixed the price of energy for lighting purposes at 5d. per unit as a flat or uniform rate, or upon the maximum demand system at 2d. per unit for all energy consumed, plus a capital sum on the basis of £7 10s. per KW. per annum; 5 per cent. discount is to be allowed on accounts settled within 14 days.

The Town Hall is to be wired for electric light.

Newcastle-under-Lyme.—The T.C. has decided not to entertain the offer of the Potteries Electric Traction Co. to supply energy to the Corporation.

Walton.—The U.D.C. has decided to apply for electric lighting powers.

Walthamstow.—The accounts for the first year's working ending September 30th, 1902, of the electricity supply undertaking have now been made up. The total receipts are £6,680 and the working expenses £2,915. After paying interest and sinking fund charges, which amounted to £2,738, there is a profit of £1,027—an extremely good result. Mr. F. A. Wilkinson, the electrical engineer, reports that there are applications in hand for 26,400 8-C.P. lamps, and that motors of 100 total H.P. are connected. It will be remembered that Westinghouse gas engines and producer plant are in use at Walthamstow.

Brussels.—On the 3rd inst., the new Brussels—Midi and Forest line which has been "electrified," was successfully inaugurated. The line was opened to the public on Tuesday.

ELECTRIC TRACTION NOTES.

Ayr.—The Corporation tramways, it is stated, for the first year's earnings show £12,504 as income. The expenditure, including 3 per cent. depreciation on capital, also interest and sinking fund charges, totals to £10,434 13s., leaving a net balance of £2,069 5s. 2d. The receipts per car-mile were 10·34d., and the expenses per car-mile 8·63d.

Barrow.—The Sub-committee has accepted the tender of the British Insulated Wire Co. for underground work and the construction of permanent way. It is said that there will have to be two kinds of car, as the Salthouse Road bridge is too low to allow a double-decker car to go under, and the probability is that the Committee will have to adopt single-deckers for Salthouse and double-deckers for other portions of the line.

Beckenham.—The U.D.C. has entered into an agreement with the B.E.T. Co., whereby the Council is to promote a Bill in the present session of Parliament authorising the construction of electric tramways in the town, and to lease the tramways to the company for 28 years. The company agrees to pay to the Council during the first 10 years 6½ per cent. per annum on the sum expended; 7 per cent. for the next five years; 7½ per cent. for the following five years; and 8 per cent. for the remainder of the term. The Council is to have the option of purchase at the end of 10 years, and to supply energy at 2d. per unit, with a minimum annual payment of £900. If any other than the overhead trolley system is adopted, the company is to have the option of withdrawing from the agreement.

Belfast.—The Belfast Tramway Co. has purchased the Ligoneil branch line, which connects that growing manufacturing centre with the city, and the Sydenham line, which serves a populous residential suburb, at £10,000 each, thus giving the company's trams a clear run of seven miles from point to point. This move has given the company advantage over the Corporation, which hoped to bring it to terms. The company has applied formally to the Corporation for permission to electrify the newly acquired branch lines and the connecting parts through the city.

Bilston.—On Thursday last week Col. von Donop visited Bilston, and made a B. of T. inspection of three additional sections of tramways constructed by the B.E.T. Co., viz., from Bilston to Bradley, from Willenhall to the Wolverhampton borough boundary, and from Willenhall to Darlaston, which are extensions of the present system. At certain points additional guard wires are to be placed over the trolley wires, and these will be attended to. The lines were opened for traffic on Tuesday.

Bradford.—For several weeks past it has been found necessary to reduce the service of cars in the evening owing to the power at the electricity works being insufficient to supply both the traction and lighting needs, but a new engine, put in by Messrs. Cole, Marchent & Morley, of Bradford, at a cost, with generator, of about £13,000, has just been started, and thus puts an end to the difficulty.

Bridlington.—The T.C. has decided to take steps to obtain electric tramway powers.

Brighton.—On 30th ult. the T.C. amended its decision with regard to the proposed line to the railway station, as it was found to be too costly. As the matter now stands, the line, instead of going up Surrey Street, will continue along Queen's Road and there stop, outside the station. Another line will start beyond the station as originally proposed. This new arrangement causes a break to be made in the lines which will, no doubt, cause inconvenience, but has one great advantage, that the cars will run right up to the station front, and thus capture many more passengers than they otherwise would have done.

Bromley (Kent).—The U.D.C. has decided to open negotiations with the B.E.T. Co., with the object of securing electric tramways for the town.

Burton-on-Trent.—A light railway inquiry was held here on 30th ult. *re* the Midland Railway's application for an order to construct an 11¼-mile electric trolley line between Burton and Ashby-de-la-Zouch, mainly along the highway but partly across fields.

Cardiff.—Mr. Arthur Ellis has reported to the Corporation authority that the sanding of the tramlines will entail an outlay of £1,500 a year, and the question has arisen who is to be responsible for it. The Health Committee appears to hold that it should come out of the profits of the trams. Mr. Ellis, however, denies all departmental liability as to the sanding of the tramlines, and the issue has now been referred to the town clerk.

Cheltenham.—The B. of T. has confirmed the order of the Light Railway Commissioners, authorising the extension of the Cheltenham Light Railway to Leckhampton and Charlton Kings in its entirety.

Dewsbury.—The matters in dispute between the B.E.T. Co. and the Dewsbury Corporation have not yet been settled, but negotiations are proceeding, and it is hoped that a settlement will come ere long. There is still a short length of road on which the line has not yet been laid. Work was suspended here nearly three months ago, owing to an objection by the Corporation to the way in which the company proposed to negotiate

a nasty corner, and nothing has been done since. The overhead equipment is being completed, and other work is being rapidly pushed forward. Several cars have already arrived, and it is expected that trial trips will be made at an early date over one or two sections. The present scheme provides for a service of cars from Dewsbury to Ravensthorpe, and the company have now agreed to apply to Parliament next session for power to continue the line from Ravensthorpe through Mirfield to Brodley, where the Huddersfield Corporation's system will be joined. In their last Bill the Huddersfield Corporation obtained powers to construct a line from Brodley to Mirfield, but they have agreed to allow the company to make this line and thus connect the two systems. Agreements between the B.E.T. Co. and the Dewsbury and Batley Corporations as to the terms upon which energy was to be supplied for the running of the cars were drawn up last May. They were not signed, however, and correspondence has recently passed between the parties, the company, it is said, asking for more favourable terms.

Douglas.—A new company, it is said, is to be formed to take over and work the Isle of Man Tramways. The debenture and shareholders are to have a preferential call on the debenture capital in the new company. A number of important improvements in the working of the lines are contemplated.

France.—A service of electric motor cars on the Lombard—Gerin trackless trolley system is about to be established in the town of Grasse.

Glasgow.—Sheriff Strachan on 28th ult. awarded £15 damages to Mrs. Paterson, cab proprietrix, Glasgow, for injury to a cab which was run into by a Glasgow Corporation electric car in Dumbarton Road on June 10th, 1901. In his judgment, his Lordship said the defenders seemed to be under the impression that they had the sole right, prior and preferable, to the use of the streets. That, of course, was a most erroneous and dangerous assumption, and he considered that drivers, or motormen, must observe at least three obvious precautions:—(1) They must proceed at a safe and moderate rate of speed. (2) They must have a thorough knowledge of the mechanism of the cars, and have them entirely under their control. (3) They must keep a proper look out, and be prepared to stop or reduce their speed when there was any danger of their coming into contact with a person or vehicle. These precautions were binding on drivers of all vehicles alike, more so to drivers of electric cars, which were the most destructive of all vehicles when not under control. The driver of the car in question had been a strapper, or stableman; had driven a horse car, and was thereafter put on an electric car. "I was," he said, "about a week on an electric car previous to the accident. I was only a week learning." His Lordship therefore thought this was a most reckless act on the part of the defenders and found as above.

Gloucester.—Great interest has been taken in the dispute between the Gloucester T.C. and the county authority as to the making of a light railway which will run out into the country districts. The T.C. can, of course, construct its own line, but there are populous districts outside, the roads in which are under the C.C., and for a long time the two bodies have been making an effort to arrive at a workable agreement. The Light Railway Commissioners have taken the matter up, and have issued a report (founded upon a recent inquiry), which contains the following significant paragraph:—

> The Commissioners consider it desirable in the public interest that the Corporation and the County Council should come to an arrangement for working a through service at through rates upon the two lines, and, if an agreement on the matter is arrived at beween the authorities before the orders are finally settled and submitted to the Board of Trade, the Commissioners will make provision therein to carry the agreement into effect. If the authorities should, in default of agreement, join in requesting the Commissioners to deal with the matter, the Commissioners would be prepared, after hearing the parties, to determine the basis on which the working arrangement must be arrived at.

Harrogate.—At a special meeting of the T.C. the tramway clauses of the proposed Parliamentary Bill—which clauses the promoters stated were to give the Corporation tramway powers not to be exercised, but merely in order to keep out the private companies—were defeated by the vote of opponents, who held that the best way to keep Harrogate unique in the respect that it had no tramways, was not to ask for powers, and to oppose everybody else who did so.

Hawick.—A strong company is going to apply for electric tramway powers.

Ilford.—The U.D.C. has decided to apply to the B. of T. for a prov. order to construct two additional lines of electric tramways.

Leicester.—A Light Railways inquiry was held here last Friday, lasting the whole day, into the application for an order to construct a light railway (electric trolley) between Leicester, Anstey, Groby and Newtown Lingord. The promoters proposed to erect a generating station at Anstey. The capital would be £150,000, viz., £112,000 for the scheme, and £37,500 for additional powers. Colonel Crompton, one of the promoters, said the idea was to make it identical with that of the Leicester electric tramways, so that if an agreement could be come to, the two might be connected. There was some opposition to the scheme, but after hearing evidence the promoters and the objectors came to an agreement, the promoters agreeing to insert a clause in the Act to the effect that the Corporation of Leicester shall have the right to purchase as much of the new railway as is within the borough within two years of traffic being begun. Lord Jersey said the Commissioners had decided to recommend the Board of Trade to grant the order, subject to the agreement arrived at.

Langen Railway System.—The report comes from Germany that a Bill for the construction by an English syndicate of a suspended railway, on the Langen system, will be laid before the British Parliament during the present session. The cost of the railway is estimated at 2 million sterling. We read in the *Financial News* that the line proposed would be 10 miles long. The works would be carried out on behalf of the English syndicate, the Continental company receiving a royalty for the Langen patent, and the Schuckert Co. one-half of the orders for establishing the electric plant.

Liverpool.—Since the acceleration of the service on the Liverpool Overhead Railway, representatives of different companies have visited Liverpool to inspect the line and to obtain particulars respecting the working. On Friday last representatives of the Great Eastern Railway were in Liverpool with these objects.

Liverpool—Manchester.—The *Journal of Commerce* states that the promoters of the Manchester and Liverpool Electric Express Railway have decided that a portion of the line shall be constructed immediately, seven miles in length, in the neighbourhood of Warrington, in order to test the section to satisfy the Board of Trade officials that the plans already approved of are workable. "It will be necessary to complete practically the construction of the generating station at Warrington, because the full electrical current will be required, for it is intended to run trains on this section of the line at speeds up to 120 miles an hour. The difficulties in the way of the promoters have been accentuated by the fact that the House of Commons Committee which passed the Bill imposed the condition that before the line was constructed the Board of Trade should give its approval to the plans of the promoters. The plans have practically been approved, but before the last word can be said on this matter the officials declare that they require to be satisfied that the plans are more than theoretically correct. This situation absolutely prevents the promoters from issuing a prospectus and getting the capital for their undertaking. However, as the result of a private appeal to a few individuals all the money required to construct the seven miles of experimental line already mentioned will be provided."

Lye and Stourbridge.—Traffic was on Saturday opened on the new branch electric tramline from Stourbridge to the Lye. The cars only travel as far as the Cross, Lye, because of some alterations yet to be completed.

Maidstone.—The T.C. on October 29th received a letter from the Chatham and District Light Railway Co. asking for consent to an extension of the existing tramway at Chatham to Maidstone. The Highways Committee recommended that a reply should be sent stating that the Council would consent to the promotion so long as it did not in any way clash with the electric tramway scheme already considered for the borough. The Council adopted this recommendation.

Manchester.—Some interesting figures were given by the chairman of the Tramways Committee a day or two ago. He said the total length of track laid and relaid, up to the present time, was about 100 miles. The cost has been £4,650 per mile, against an estimate of £5,210. The estimated cost of overhead equipment and rail bonding was £1,764 per mile, but the work had actually been done at £1,000 per mile. In 10 months, ending March 31st last, the number of passengers carried was 23,603,248; in the six months ending September 30th, the number was 26,418,591. The receipts for the same 10 months were £91,619; and for the six more recent months £119,385, the difference being accounted for by the greater length of track open. The average receipts per car-mile were 1s. during the 10 months, 1s. 0¼d. during the six months. The Committee estimate their gross receipts for the year ending March 31st, 1903, at £250,000.

Manchester to Altrincham.—With regard to the several schemes for this district, it is now definitely known that the Manchester Corporation intends competing for the traffic. No private company could work it successfully—nor indeed could any local authority—without running powers over the Manchester City lines; and Manchester seems determined that no authority, public or private, shall have such powers if it can possibly prevent them. The idea of Manchester is to make a tramway from the terminus of the present lines in Stretford, through to Altrincham, which would enable it to control the whole traffic, and also to compete with the Manchester, South Junction and Altrincham Railway.

North-Eastern Railway.—The tenders for electrifying certain sections of this railway are now under the board's consideration. They were informally considered last Friday week, but it will be a few weeks before any definite decision can be arrived at.

A daily paper says that this company has ordered a number of 100-H.P. four-cylinder petrol engines, to be utilised for the propulsion of light and frequent trains on local branches. The engines are to be constructed by the Motor-Power Co., London.

Penge.—The Croydon and District Tramway Co. has informed the U.D.C. that it intends to apply for powers to construct a line from Beckenham to Penge.

Ripon.—The London Power and Traction Co. has asked the T.C. to consent to the company laying electric tramways from

the station to the city, and thence to Studley Park, and requested an interview. The matter has been referred to the Highway Committee.

Reading.—The T.C. on October 30th decided to ask the Reading Electric Supply Co., Ltd., to quote for temporary supply of energy for a period of from three to six months to drive 12 or more cars.

Shipley—Bradford.—The award of Mr. A. Baker, arbitrator on the matters in dispute between Shipley U.D.C. and Bradford T.C. as to the electric tramways in the former's district, states that the lease shall be for 30 years; that Bradford shall pay interest and sinking fund charges at the rate of £5 14s. 6d. per cent. per annum for 30 years on the sum of £27,614 expended on construction, and £4 10s. 3d. per cent. on £12,642 expended on street improvements; that the U.D.C. shall supply energy at 1¼ per unit, the price to be subjected to revision every five years; and that the U.D.C. shall maintain the tramway, with the exception of the overhead equipment, charging the T.C. £100 per mile per annum.

South Shields.—A special meeting of the T.C. was held on the 29th ult. for the purpose of considering the promotion of a Bill for the construction of new tramways. The principal lines will be from King Street *vid* Fowler Street to Westoe, and between Westoe and Tyne Dock with other lines connected thereto. The Council also seek power either to lease the tramways or to work the traffic themselves, and powers to arrange an interchange of traffic with any adjoining company. The Mayor, Councillor Beattie, moved the adoption of the formal resolutions, and this was seconded by Alderman Wardle. Alderman Scott asked the chairman of the Committee if he thought seriously for one moment that, if the tramways were let, or advertised to be let, the Council would expect to get 3½ per cent. and the redemption upon £230,000. The question was ruled out of order. The motion was eventually carried by 28 as against 4, two remaining neutral. The matter as to municipalisation still remains in abeyance.

Spain.—Plans are being prepared in respect of a projected electric railway between Los Morteras de la Rumia and Fuente de los Ferros. It is proposed to utilise the water-power of the River Pajares (province of Oviedo) in the generation of the necessary electrical energy.

Swansea.—The Corporation Electric Lighting Committee has decided to accept the invitation of the directors of the Dolter system of electric traction, to take the members to Paris to see the system in actual work. Incidentally, the Hon. Odo Vivian opposed the suggestion, as he said Edison had invented a storage battery which would revolutionise electric traction. It is true that Mr. Edison has invented a battery, but who knows yet what it will do on the road?

Sydney.—On September 26th the State Premier intimated that the Government was considering the question of providing for additional machinery in connection with the electric tramways. "Electric power at present in use at the power house is found to be practically taken up with the existing trams, sufficient only being left for some short lines now nearly completed. But the Government has under consideration a number of proposals for other tramways, and these, together with the development of existing lines, will necessitate more machinery. There is accommodation at the power house for this machinery, but the Government wishes to obtain the best and most up-to-date class, and the point to be settled is the kind to adopt. Several designs have been under consideration, and a decision will be come to at an early date. The machinery will have to be ordered without delay, as it will be about 18 months before the plant can be put in working trim."—*Sydney Daily Telegraph.*

Torquay.—After a lengthened discussion, the Council has decided to consult an expert on the subject of the tramway routes, and the choice of the professional adviser has been left to the Mayor and Mayor-elect; the fee is not to exceed 400 guineas.

Warrington.—The T.C. has instructed Messrs. Preece and Cardew to prepare the necessary plans and estimates for the construction of a line of electric tramways from the terminus at Wilderspool to Stockton Heath.

Warrington and District.—Difficulties which have arisen in respect of the order to authorise the Warrington Corporation light railways, which would form the connecting link between the Warrington and Northwich light railway and the borough of Warrington, have prevented the Light Railway Commissioners from settling the order in question. The Commissioners consider that the two orders should be settled and go forward at the same time, and hoped during the course of the next week or so to be in a position to settle the terms of the two orders.

Worthing.—The T.C., on the advice of the Parliamentary agents, has decided to proceed by way of private Bill for powers to construct electric tramways, instead of under the Light Railways or Tramways Acts, in order to facilitate matters.

TELEGRAPH AND TELEPHONE NOTES.

Brighton Telephones.—The T.C. has received permission to borrow £42,000 for the establishment of a municipal telephone service.

Bournemouth Telephones.—A joint conference of local authorities in the Bournemouth telephone area has passed resolutions recommending that a municipal license be applied for if expert opinion is favourable.

The British and American Pacific Cables.—A Reuter's telegram from Wellington (N.Z.) states that Sir J. G. Ward, the acting Premier in the absence of Sir Richard Seddon, confirms the report that the plan of the New Zealand Government for a cable between Honolulu and Fanning Island is practically accepted. This cable, when laid, will have the effect of uniting the Pacific cable with the American line, which will be laid in the course of the next few months between California and the Philippines.

The Completion of the Pacific Cable.—The following are some memoranda regarding the Vancouver (Bamfield Creek) to Fanning Island section of the British Pacific cable reported in the London Press of October 7th, 1902, as follows:—

"The *Colonia* buoyed up the end of the Pacific cable one mile off Fanning Island at 11 o'clock this morning. The total length of the cable is 3,455 miles, being 85 miles less than was anticipated."—*Through Reuter's Agency.*—Victoria (B.C.), October 6th.

Now taking the overground distance at the figure given by Admiral Wharton—viz., 3,220 N.M.—and the actual cable length as 3,455 N.M., we find that the percentage of slack equals 7·13 per cent. actual after laying.

As regards the carrying capacity of this section as specified and laid, we will assume that the electrical values come just within the specification. We then have 3,455 N.M. of cable with a core of 600 lbs. of copper and 340 lbs. of gutta-percha to the N.M.; the C.R. per N.M. at 75° F. not exceeding 2·03 B.A. ohms, and the maximum I.C. per N.M. being 0·440 microfarad. The bottom temperature along the route is 35·3° F., as found by the ss. *Britannia.*

Taking as a basis of calculation one of the longest Atlantic cables, we find this section of the Pacific cable, as actually laid, should give a simplex working speed of 61·5 letters per minute, to which if we add 90 per cent. for duplex working we get 116·8. To this figure add 40 per cent., the increase which Dr. A. Muirhead ascribes to the use of the automatic curb, and we get 163·5 letters per minute as the possible speed over the Vancouver—Honolulu section.

As concerns "paying-words" transmitted, this, of course, depends on the conditions under which the line is managed, but taking the same conditions and management as prevails in the Commercial Cable Co.'s service, we find that of all the words which pass over these cables 84 per cent. are paid for. On this basis we have 137 letters, which, taking the word at eight letters, is equal to 17 "paying-words" per minute.

In the evidence taken before the Pacific Cable Committee in 1896 we find the following estimates given, as shown in the minutes of proceedings in Blue Book, No. C. 9,247 of 1899. These estimates are here given in the order of their approximation to the actual figures:—

Witness.	Overground distance.	Cable length.	Slack after laying.	Core suggested.
As laid.	**3,220**	**3,455**	**7·13 %**	**600/340**
Lord Kelvin (Appendix No. 17) ..	—	—	—	552/368
Mr. Theos. Smith, for Messrs. Henley & Co.	—	—	Not more than 7 or 8 % Q. 739	650/400
Mr. M. H. Gray, for Silvertown Co.	3,222 Q. 867	3,555	Not more than 10 %	552/368 Q. 418
Sir Sandford Fleming	3,240 Q. 104	3,600	11 %	—
Mr. Alexander, for Messrs. Siemens & Co.	—	—	—	500/330
Sir George Richards (Tel. Construction Co.) per Mr. F. R. Lucas	3,216 Q. 820	3,650	10 %	—
Mr. F. R. Lucas, for Tel. Construction Co.	—	—	10 to 12 % Q. 819	650/400
Sir W. H. Preece, for General Post Office	3,198 Q. 1,812	3,710	12½ % Q. 1,334	940/940 750/600 650/400
The Marquis of Tweeddale Mr. H. A. C. Saunders Mr. F. E. Hesse for the Eastern Tel. Co.	3,300 Q. 1,911	3,729 to 3,795	13 to 15 % Q. 1,896	650/400
Mr. Herbert Taylor (Messrs. Clark, Forde & Taylor)	—	—	—	650/400 Q. 1,103
Hon. W. P. Reeves .. .. .. Q. 3,209	—	—	10 % would be ample.	—

NOTE.—Q. gives reference number to Question in the Blue Book above mentioned.

To the above we would add that the estimate of the slack required, as calculated by Sir Charles Todd, Postmaster-General of South Australia, was 20 per cent., quoted by the Hon. Thomas Playford at the Ottawa Conference.

Cable Monopoly in China.—In the House of Commons on the 30th ult., Sir E. Sassoon asked the Postmaster-General whether he could instruct the Government of Hong Kong to make it publicly known that landing rights will forthwith be granted to any individual or company seeking for them in Hong Kong and its dependencies, under reasonable conditions, for purposes of laying cables, to which Mr. Austen Chamberlain replied:—The instructions suggested by the hon. member cannot be given to the Governor of Hong Kong, in view of the terms of an agreement made in 1893 with the Eastern Extension Telegraph Co.

German Submarine Telegraphy.—One-third of the German submarine telegraph cables are State concerns, while the other two-thirds are in the hands of private companies. *Engineering* says that of the world's total mileage of submarine cables, only 4 per cent. belongs to Germany.

Pollak-Virag Telegraphy.—Under instructions from he Hungarian Minister of Commerce, a regular service has been started between Pressburg and Buda-Pesth by means of the Pollak-Virag system of rapid telegraphy.

Railway Metal Telegraphy.—A series of experiments has recently been conducted by Mr. J. Edgar, of Nithsdale, Wrexham, on the metals of the private railway belonging to the Llay Hall Colliery, with powerful telegraph plant supplied specially by the National Telephone Co. The object of the invention is the utilisation of the rails for a variety of practical purposes. For instance, any engine or guard's van, if properly connected, can during the course of a journey be immediately stopped at any point, or again, the engine driver or guard (who can speak to each other in transit) can also speak to the nearest station or signal box *en route*, thereby preventing accident or other casualties. In case of the engine driver or guard being unable to see signals during a fog, the signalman would be able to communicate a message. If experience bears out the results so far obtained, the invention will be of great utility.

Swansea Telephones.—At a meeting of the Swansea Trades' Council, Mr. W. C. Jenkins, one of the elective auditors, said that he felt constrained to utter a word of warning in regard to the establishment of municipal telephones. Owing to the speculative and competitive character of the project, the strongest safeguards should be taken that the general body of ratepayers would not be ultimately mulcted for the supply of a commodity which would only be used by a restricted number of the ratepayers. Methods which would be condemned as unsound and fictitious in ordinary commercial circles should be eschewed.

Underground Telegraphs.—The *Daily Telegraph* states that the Post Office has now practically completed the scheme of underground telegraph wires which Lord Londonderry, in the early part of the year, promised should be laid in all the principal storm centres between London and Scotland. The mains are now laid along the three most exposed sections on the route between London and Edinburgh and Glasgow. The first is from Stafford to Warrington, the second from Preston to Preston Richard (which is about 10 miles north of Lancaster), and the third along the steep incline on the London and North-Western Railway from Kendal to Shap. Communication between London and Manchester and Liverpool by underground wires is now complete. The mains on all three of the new sections are now laid, though the cables have not yet been taken through the whole of them. The newly-constructed lines are not in any way intended to supersede the present overhead wires, and in ordinary times they will be completely idle, since they are less effective and more expensive to maintain.

Wireless Telegraphy.—Mr. Marconi arrived at Table Head on November 1st on board the Italian cruiser *Carlo Alberto*. He stated that his experiments while crossing the Altantic had been successful.

On his arrival at Table Head, Marconi is reported as saying "I will not say whether or not I was in constant communication with Cornwall on the voyage across the Atlantic."

The Central News, on the other hand, says that the "warship kept in communication with Poldhu without interruption."

Reuter announces from St. Petersburg that one of the warships in the Russian Squadron under Rear-Admiral Stakhelberg, which is proceeding to the Pacific Ocean, will have on board M. Korinfsky, head of the factory of wireless telegraphic apparatus. M. Korinfsky is being sent on this mission by the Russian Ministry of Marine for the purpose of instructing the officers of the squadron in the practical use of wireless telegraphy and the manner in which it is to be employed in communicating between ships and with the coaling stations. He will also acquaint himself with some of the peculiarities connected with the use of wireless telegraphy at sea. His mission will extend over a period of three months.

The *Standard's* Berlin correspondent says that the wireless telegraph station at Sassnitz, on the Island of Rügen, has been inspected by a party of officers belonging to the Aeronautic Battalion and the Army General Staff. Endeavours were made to intercept, or to interrupt, the communication between Sassnitz and the station at Gross Mölln, in the district of Göslin, but without success. Similar experiments are to be made by the warship Neptune and the torpedo-boat S. 36 in the harbour of Sassnitz.

For rather more than two years Marconi's Wireless Telegraph and Signal Co. has maintained the necessary instruments to enable wireless telegraphy communication to be maintained between the street station at Streatham Green and the L.C.C. Fire Brigade temporary sub-station in Mitcham Lane. It has been arranged that the installation shall be retained until the completion of the permanent Streatham station next September.

CONTRACTS OPEN AND CLOSED.

OPEN.

Aberdeen.—November 26th. Electrically-driven tower wagon for overhead tramway repairs. See "Official Notices" to-day.

Army Contracts.—A list of articles for which the War Office invites tenders from time to time, including cables, electrical stores, scientific instruments, traction plant, wires, &c., appears in our advertisements to-day.

Blackburn.—November 24th. Boilers, stokers, superheaters, economisers, feed pumps, pipes, condensers, ash and coal conveying plant. See "Official Notices" to-day.

Bristol.—November 14th. Arc cables. See "Official Notices" October 24th.

Brussels.—November 19th. The Belgian State Railways Administration wants tenders for telegraph insulators.

Buckinghamshire.—November 8th. Electric lighting, telephones, and tell-tales for the County Asylum. See "Official Notices" October 31st.

Copenhagen.—November 17th. Two dynamos, switchboard, &c. See "Official Notices" October 17th.

Dartford.—November 12th. House wiring. See "Official Notices" October 24th.

Dewsbury.—November 8th. Electric light installation at the Infirmary. Particulars from the borough electrical engineer.

Dumbarton.—The T.C. having obtained a provisional order, is prepared to consider proposals by electric supply companies, either for the supply of electricity in the burgh or for the taking over and carrying out of the order.

Durban.—December 5th. (1) Complete telephone exchange equipment, 7,200 lines; (2) Underground dry-core air-space cables for the Corporation. See "Official Notices" to-day.

Erith.—November 12th. Meters and cut-outs. See "Official Notices" October 31st.

Finchley.—November 24th. Boilers, balancing sets, crane, batteries, mains, street lighting, &c. See "Official Notices" to-day.

France.—January 1st. The Prefectural authorities of the department of Calvados are inviting projects until January 1st, 1903, for the construction and working of an electric tramway, for the transport of passengers and goods between Trouville and Honfleur, a distance of about 10 miles. Particulars may be obtained from, and proposals are to be sent to, La Prefecture de Calvados, Caen.

Halifax.—November 20th. 750-KW. steam dynamo with condenser. See "Official Notices" October 24th.

London.—November 18th. The L.C.C. invites tenders for road-work and plate-laying for the reconstruction of certain tramways on the conduit system. Engineers' Department, Spring Gardens.

Lowesoft.—November 26th. Overhead equipment and poles; cables, &c, for tramways. See "Official Notices" Oct. 31st.

Malta.—November 28th. The local authority at Valetta wants offers for the concession of electric tramways connecting Valetta and Cospicua, Senglea and Vettoriosa and the Casal Zebbug. Particulars from Mr. Wm. Casolani, Receiver-General and Director of Contracts, Valetta, Malta.

Newcastle-upon-Tyne.—November 8th. A triple-expansion direct-coupled 3,000-H.P. engine for the Corporation tramways station. Mr. A. E. Le Rossignol, general manager and engineer. Deposit for specifications, £3 3s. See "Official Notices" October 17th.

Pontypridd.—November 22nd. Tramways, permanent way, traveller and storage battery. See "Official Notices" Oct. 31st.

Radcliffe.—November 14th. Steam dynamos; boilers, superheaters and economisers, condenser and pumps. See "Official Notices" October 31st.

Salford.—November 12th. Lead-covered wire. See "Official Notices" October 31st.

Santiago de Cuba.—November 15th. The Municipality of Santiago de Cuba is open to receive offers for installing an electric lighting system in the town.

Southampton.—November 18th. (1) Car bodies; (2) electrical equipment and tracks. See "Official Notices" October 24th.

Spain.—November 8th. The municipal authorities of Tarrega (Catalonia province) are inviting tenders until November 8th for the concession for the electric lighting of the town during a period of 15 years. Particulars may be obtained from, and tenders are to be sent to, El Secretario del Ayuntamiento de Tarrega (Catalonia).

Spain.—November 28th. The municipal authorities of Chinchilla are inviting tenders until the 28th inst. for the concession for the public and private electric lighting of the town during a period of 15 years. Particulars may be obtained from, and tenders are to be sent to, El Secretario del Ayuntamiento de Chinchilla, Spain.

Stalybridge. — November 24th. Motor-generators, switches, starting motors and transformers, booster sets, balancers, air compressors, accumulators and travelling cranes for the Stalybridge, &c., Tramways and Electricity Board. See "Official Notices" to-day.

Sunderland.—November 28th. Steam dynamo, three-phase motor-generators and transformers, and switchboards. See "Official Notices" October 17th.

Tien-Tsin. — November 30th. The Municipal Secretary at Tien-Tsin is calling for proposals for the lighting of the British concessions by electricity. See this column for August 15th.

CLOSED.

Burnley.—The tender of Messrs. Dick, Kerr & Co. to supply and erect a generating set, for the sum of £2,500, has been accepted.

A sub-contract has been let by Messrs. Dick, Kerr & Co. to Messrs. Belliss & Morcom for a 360-H.P. engine.

Bury (Lancs.).—The T.C. has accepted the tender of Messrs. Askham Bros. & Wilson, Ltd., for the supply of cast-steel points and crossings, with renewable parts for the electric tramways, and that of the Forest City Electric Co., of Manchester, for copper bonds.

Dewsbury.—The tender of the Electric Construction Co., Ltd., has been accepted by the Corporation for the supply of a centrifugal pump at the electricity works at £154.

Finchley.—The D.C. have accepted the tender of Messrs. Hockley & Co., of Grantham, for the erection of the electric light station, and it is hoped that the plant will be running about the middle of next year.

India.—The tender of D. Bruce Peebles & Co. for three-phase plant for the Mysore Gold Co. has been accepted.

King Williamstown.—Messrs. Belliss & Morcom have received a sub-contract from the Electric Construction Co. for four engines.

Ladysmith.—Willans & Robinson, Ltd., of Rugby, have received an order for two 100-H.P. engines for the electricity works.

Leicester.—The tenders of the North-Eastern Steel Co., Ltd, of Middlesbrough, for 4,800 tons of steel rails and 175 tons of fishplates at £32,325 19s., and Messrs. Hadfield's Steel Foundry Co., Ltd., of Sheffield, for the supply, delivery and construction of special track work at £13,041 10s., has been accepted.

London. — The National Telephone Co. have again accepted the tender of Messrs. Rowland Carr & Co. for the supply of insulating compound required by the company for a further six months, in addition to this year's supply.

Middlesex.—The C.C. have resolved to accept the tender of Messrs. J. G. White & Co., Ltd., for the construction of a light railway from Cricklewood to Edgware. The amount was £49,881 5s. Messrs. W. Griffiths & Co.'s tenders for a light railway along the Archway Road and the Great North Road, and for a line in Lordship Lane and Bruce Grove, Tottenham, have also been accepted.

Great North Road line	£50,224 16 3
Tottenham line	28,339 3 8

Rotherham.—The T.C. has accepted the tender of Messrs. Babcock & Wilcox, for extension pipework at £1,716, and Messrs. Kelvin & White, of Glasgow, for extension of switchboard, at £843 for the electricity works.

St. Petersburg.—It is announced that the municipal authorities of St. Petersburg have definitely placed the contract for the establishment and equipment of a telephone exchange in the city for 12,000 subscribers, and also the necessary subscribers' instruments, with the Antwerp Telephone and Electrical Works, their offer being selected out of the five received. The installation of the telephone exchange will comprise 30 multiple commutators of the Kellogg type and will cost 38,390 roubles. The bulk of the plant and apparatus will be supplied from the company's works in Antwerp and Chicago, while the work of installation will be carried out by Messrs. V. Saveliew & Co., of St. Petersburg, the Russian agents of the company.

South Wales.—Willans & Robinson, Ltd., of Rugby, have received an extension order from the South Wales Electrical Power Distribution Co. for four 360-H.P. engines.

War Office.—Messrs. D. Bruce Peebles & Co. have sublet an order for engines to Messrs. Browett, Lindley & Co., for driving their dynamos ordered by the Ordnance Department, for Waltham Abbey.

West Ham.—The tender of Messrs. Estler Bros. for 45 combined lighting and traction poles for the electric trams, at £10 15s. each, has been accepted.

West London.—The following is a list of the tenders received for the electric lighting of the West London District Schools in accordance with the specification:—

	Contract No. 1. Scheme No. 1.	Contract No. 1. Scheme No. 2.	Contract No. 2.
Statter & Co., J. G.	£1,380	£1,514	—
Electric Construction Co.	901	1,002	—
Johnson & Phillips	795	868	—
Manchester Elec. Power and Lighting Co.	—	—	£1,350
Mackrill & Sons, C.	—	—	1,148
Cooper & Co., C.	1,195	1,430	1,045
Tamplin & Makovski	885	1,160	1,181
Coleby & Co., F. J.	1,023	1,208	1,175
Donnison, Beriyn & Sillem	900	1,170	800
National Electric Wiring Co.	884	1,015	695
South, Harry	900	1,100	800
Robb & Mitchel	908	1,113	772
Weston & Co., G.	907	900	800
Glover, F. A., & Co.	780	938	676
Woods, H. G., & Co.	740	970	790
Firth & Son, D.	854	1,047	582
*Dawson, R., & Co., Stalybridge	779	911	655
Blackburn, Starling & Co.	765	941	649

Tenders subject to special conditions as per covering letters, or with alterations or additions to the specification:—

Peebles, D. Bruce, & Co.	£1,115	£1,308	—
Crompton & Co.	806	1,073	—
Parker, T., Ltd.	802	978	—
Jackson, P. B., & Co.	770	923	—
Holmes & McCallum	698	852	—
Mather & Platt, Ltd.	626	840	—
General Electric Co.	745	787	—
Troup, Curtis & Co.	1,868	2,032	£2,032
Scott, Mountain & Co.	995	1,190	1,177
Brush Electrical Engineering Co.	887	1,067	1,275
Ward Bros.	941	1,139	1,084
Thames Electrical Engineering Co. ..	679	856	1,188
Sunderland Forge, &c., Co.	939	1,094	705
Lea & Warren	735	920	600
Nicholson & Co.	799	881	696

Accepted Contract No. 1, Scheme No. 2, and Contract No. 2.

Wolverhampton.—The T.C. on Friday accepted the tenders of the District Electric Co., of Wolverhampton (£154 10s 4d. and £108 16s. 3d. respectively), for wiring the new offices at the Town Hall.

FORTHCOMING EVENTS.

Friday, November 7th.—At 7.30 p.m. Faraday Club. Dinner at St. Ermin's Hotel, Mr. J. Swinburne in the chair.

Tuesday, November 11th.—At 8 p.m. Institution of Civil Engineers. Ordinary meeting. Paper to be submitted for discussion on "Electric Tramways," by C. Hopkinson, B.Sc., B. Hopkinson, B.Sc., and E. Talbot.

At 8 p.m. Institution of Electrical Engineers (Glasgow Section). Inaugural Address by Mr. H. A. Mavor.

Wednesday, November 12th.—Association of Engineers-in-Charge. Visit to Messrs. Thorneycroft & Co.'s works at Chiswick. At 8 p.m., paper on "Mechanical Ventilation," by W. G. Walker.

Thursday, November 13th.—At 8 p.m. Institution of Electrical Engineers. Premium presentation and Presidential Address by Mr. J. Swinburne.

Friday, November 14th.—North-East Coast Institution of Engineers and Shipbuilders. Meeting at Newcastle.

Electro-Harmonic Concert (Ladies' Night) at the Crown Room, Holborn Restaurant. Extra tickets of admission may be obtained from Mr. W. E. Lane, the hon secretary, at the reduced price of 1s. each.

Saturday, November 15th.—Institution of Junior Engineers. Visit to Messrs. Yarrow & Co.'s new shipbuilding and marine engineering works, Poplar. Train leaves Fenchurch Street at 9.13 a.m.

NOTES.

The Lightning Conductor.—This is the title of one of Methuen's popular 6s. novels. Not having perused it we are at a loss to understand whether it deals with the man at the wheel of a contemporary, an extra nimble gentleman who officiates at one end of an electric tramcar, or a copper strand decorating a high chimney stack. Possibly Mr. Killingworth Hedges can enlighten us?

Manchester Section of the I.E.E.—The complete syllabus of this section of the Institution of Electrical Engineers, for Session 1902—1903, has now been issued, and a list of the papers are given below. It will be seen that they cover a wide range of subjects, and are eminently practical. Visits will be paid to the generating stations of Manchester and Salford, the dates of which are yet to be arranged.

Tuesday, November 11th.—W. S. Goodrich, A.I.M.E. "Electricity from Refuse, the Case for the Modern Destructor." (With lantern illustrations.)

November 25th.—R. S. Hutton and J. E. Petavel. "High-Temperature Electro-Chemistry. Notes on Modern Experimental and Technical Furnaces." (Illustrated by experiments.)

December 16th.—Dr. E. W. Marchant. "Electrical Haulage on Canals." Hardman A. Earle, M.I.C.E., M.I.E.E. (chairman).

January 20th, 1903.—Presidential address.

February 3rd.—J. S. Highfield, M.I.E.E. "The Possible Developments of Electrical Driving in Factories, due to the Supply of Electricity at Cheap Rates by Large Power Companies."

February 17th.—E. W. Cowan, M.I.E.E., and L. Andrews, M.I.E.E. "The Arrangement and Control of Long-Distance Transmission Lines."

March 3rd.—G. F. Metzger, A.M.I.C.E., M.I.E.E. "Coal and Fuel Consumption at Central Stations."

March 17th.—C. D. Taite, M.I.E.E., and R. S. Downe, A.M.I.E.E. "Comparison between Steam and Electricity-Driven Auxiliary Plants in Central Stations."

April 7th.—A. H. Gibbings, M.I.E.E. "The Carriage of Goods on Electric Tramways." (With lantern illustrations.)

Wiredrawn Messages.—Interest will have been felt in the statements made last week by an esteemed contemporary of ours as to the interceptions of Messrs. Marconi & Co.'s recent and much-advertised messages to the *Carlo Alberto*. The true facts respecting these messages are a matter of common knowledge in electrical circles, although apparently unknown to the lay Press generally. For example, take, amongst others, the subjoined notes upon the subject, which we reproduce *verbatim* from the *Westminster Gazette* of September 5th last. The italics are our own:—

"Mr. Marconi is, however, at work sending messages *from* the *Mediterranean* to his English station at Poldhu, and *receiving a continuous series of replies* . . . the messages are being received and *answered regularly with every success*."

The above statements are a type of the "wireless" information which is being inserted in the daily papers for the edification of the "man in the street." But, in all seriousness, what specimen of the genus, upon reading such things, could imagine the truth viz., the wholesale interception of the messages in question; the exceedingly slow and laboured transmission; the repetitions necessitated; and the fact that the long-distance replies, if any, from the Mediterranean were received by other than wireless means!

So far we have seen no correction of the *Westminster Gazette's* assertions on the part of the representatives of the Marconi Co., neither has there been brought to our notice any contradictory letter or statement on the subject from the one physicist of eminence in this or other countries who, from the first, would seem to have followed with unflagging interest the fortunes of Messrs. Marconi's wireless ventures.

The Institution of Junior Engineers and the Electrical Volunteers.—On Thursday evening, October 30th, the members of this Institution were afforded an opportunity of visiting the headquarters of the Electrical Engineers (R.E.) Corps of Volunteers, Regency Street, Westminster, and a large number availed themselves of it. They were received by the commanding officer, Major R. S. Erskine, M.I.E.E., and staff. A short description of the general work of the Corps was first given. Their duties consisted principally of the running of searchlights at different positions round the coast. There were at present nine such stations equipped with apparatus for the use of the Corps, and no member was considered efficient unless he had served a period of training at one of these stations. Captain J. H. S. Phillips explained the construction and working of the 25-H.P. Hornsby-Ackroyd oil engine, which is used for driving the compound-wound dynamo, giving a current of 80 volts and 200 amperes. This plant is the standard set installed at the stations for instructional purposes. The facility with which the engine could be started was shown. One of the portable searchlight sets which had done duty in South Africa was connected up, and the special features of the mounting of the lamp and general equipment were indicated. Three other lamps were also inspected, and an interesting object was a small lamp used by the Boers, fitted with a shutter, by means of which signalling by the Morse code could be carried out, but as it was only of small power its utility to any extent seemed opened to question. The Morris tube range, armoury, and other departments were shown, and throughout the inspection, which occupied two hours, the officers of the Corps gave the members much useful information with reference to all that was seen. For their courtesy the thanks of the Institution were expressed by the chairman, Mr. Kenneth Gray, at the conclusion of the visit.

Concert Notices.—For next Friday the Electro-Harmonic Society has arranged a Ladies' Night as mentioned under "Forthcoming Events" to-day. We understand that the programme is of an interesting character and likely to appeal to all tastes. There is at 7.45 p.m. the same evening a smoking concert to be held at the Headquarters of the Electrical Engineers R.E. Volunteers, in Regency Street, Westminster, with Major R. S. Erskine, O.C., in the chair.

The Engineering Standards Committee.—Mr Leslie S. Robertson, the secretary of the Engineering Standards Committee, informs us that Commander G. L. Sclater, R.N., and Mr. L. J. Steel have been appointed to represent the Admiralty upon the Committee on the Standardisation of Electrical Plant, of which Sir William Preece is chairman. The following is an advance list of the Committee:—Sir William Preece, K.C.B. (chairman); J. Gavey, Esq., engineer-in-chief to the Post Office; Colonel Holden and Capt. A. H. Dumaresq, representing the War Office; Commandant G. L. Sclater, R.N., and L. J. Steel, Esq., representing the Admiralty; A. P. Trotter, Esq., representing the Board of Trade; Colonel Crompton, C.B. (Crompton & Co.); Philip Dawson, Esq.; S. Z. de Ferranti, Esq. (S. Z. de Ferranti, Ltd.); Robert K. Gray, Esq. (India-Rubber, Gutta-Percha and Telegraph Works Co.); Mark Robinson, Esq. (Willans & Robinson); R. Percy Sellon, Esq.; Alexander Siemens, Esq. (Siemens Bros. & Co.); James Swinburne, Esq.; C. H. Wordingham, Esq.

The Chatham Tramway Accident.—Another lamentable electric tramway disaster has to be recorded, this time on the Chatham Co.'s system, through an overcrowded car getting beyond control on a down grade and turning over at the curve at the bottom. So far there have been three deaths and a large number of other passengers were injured more or less seriously. The accident occurred to one of the electric cars of the Chatham and District Light Railways Co. on Thursday at Old Brompton. The car was considerably overloaded with dockyard men. The dockyard men fairly "small-gang" the cars, and it is useless the conductors protesting. The car was only built for about 50 passengers, and yet, although many had jumped off, after seeing that the car was running down the hill at an alarming speed, it is stated that there were some 70 persons riding. The Gillingham Council, it seems, had urged that alterations should be made at the corner, but the Board of Trade did not think it necessary to take any steps in the matter.

The inquest was opened on Monday, and Major J. W. Pringle was present as representing the Board of Trade. Evidence as to overcrowding was first given.

Edward James Fraser, the conductor of the car, said that at the top of Westcourt Street there was a wait of about five minutes for a pilot, and as he did not come, "we went down ourselves." After proceeding six or eight yards he felt the car give a sudden lurch forward, and he knew then that the wheels were locked. He heard the driver using the sand pin for the purpose of making the wheels revolve. Witness was standing at the back of the car with the point bar in his hand to shift the points at the bottom, and before he could turn round he was pushed off into the roadway. When he recovered he saw the car overturn at the bottom, and he went and rendered what assistance he could. He believed that the car travelled down the hill at the rate of 15 miles an hour. It was habitual for the early morning car to be overcrowded. He had only had four months' experience as a conductor. It was not usual for a pilot to go on the first car down the hill. There was a pilot there sometimes, and when he was at the top he took the car down. There were three brakes on the car, the power brake, the hand brake, and the slipper brake, and the driver used them all. The rails were very greasy down the hill that morning. He suggested that the driver had better go down alone, though the car was overcrowded. The hand brake was of no use, because the wheels locked. He could not tell whether any sand went on to the rails. Witness could not assist the driver with the brakes when he was at the back of the car. He attributed the accident to the greasy state of the rails. He did not know any particulars of a previous accident at the bottom of the hill. He was not allowed to touch a brake unless he got a signal from the driver. Then he could use the slipper and hand brake. He received no signal from the driver on this occasion.

John Coffey, a pilot in the employ of the company, said that it was his duty to take all cars down the hill. One driver was discharged two months since for taking a car down the hill without a pilot. On this occasion witness was at the bottom of the hill when he saw the car coming down. He would have taken the car down himself notwithstanding the greasy state of the line, and with more than the proper number of passengers on it. The wheels were jammed. He believed that if he had been on the car he could have reduced the speed by one-half, and taken it round the curve. The reason that he was not at the top of the hill was because he wanted to regulate the traffic at the bottom. He attributed the accident to the driver placing too much reliance on his hand brake.—The inquiry was adjourned.

Major Pringle, on behalf of the Board of Trade, has held his inquiry into the disaster. Several witnesses were examined as to the working of the tramways and the conditions existing on the morning of the accident. Major Pringle will report his finding to the Board of Trade in due course. Meanwhile the company have, on their own initiative, closed the section of the track on which the accident took place with the object of improving the curve.

Exhibition at St. Petersburg.—It has been decided to hold an electrical exhibition here in the early part of next year.

Civil and Mechanical Engineers' Society.—At last night's meeting of this Society, the presidential address was read on "Russian Engineering Works as a Profitable Investment for British Capital," by Mr. C. T. Hanssen, A.M.I.C.E.

A Motor Car Anniversary.—For to-morrow (Saturday) a tour has been arranged by the Automobile Club, from London to Oxford, to commemorate the anniversary of the passing of the "Locomotives on Highways Act (1896)."

Personal.—Mr. W. Chas. Graeme Welton, having accepted the post of electrician for a South American town, is leaving for that place on or about December 12th. Mr. Welton is better known in the Southern States and Mexico as "the deaf electrician."

It has been reported in the newspaper press that Mr. C. T. Yerkes has made a tempting offer to Mr. H. H. Vreeland, president of the Metropolitan Street Railway Co., of New York, to come to London to direct his tube railway schemes.

Mr. John Denham, electrical engineer to the Railway Department of the Cape Government Railways, has been appointed to act as the electrical expert to the Treasury, and also to act as electrical inspector under the Electric Lighting and Power Act.

Mr. Eadley Stanley, of the British Prism Globe Electrical Co., who has been in California for some months for his health, has returned, and re-opened his old offices at 57, Chancery Lane.

Nernst Lamps.—With reference to the advertisements which have recently appeared warning users against infringements, Messrs. Veritys, Ltd., who are selling large quantities of these lamps, inform us that they have made special arrangements whereby they are fully entitled to supply the trade generally with these goods, and are quite prepared to guarantee them as regards infringement.

Appointments Vacant.—Tramways inspector for Birkenhead Corporation; switchboard attendant for Maidstone (£78); sub-station assistant for Walsall; engineer-in-charge for Bermondsey electricity works (£104).

Royal Institution.—The annual course of Christmas lectures, specially adapted to young people, at the Royal Institution, will be delivered by Prof. H. S. Hele-Shaw, LL.D., F.R.S., whose subject is "Locomotion: on the Earth; through the Water; in the Air." The first lecture will take place on Saturday, December 27th, at 3 o'clock, and the remaining lectures will be delivered on December 30th, 1902, and on January 1st, 3rd, 6th and 8th, 1903.

For Sale.—Messrs. Wheatley Kirk, Price & Co. will shortly sell by auction five Willans engines coupled to Edison-Hopkinson dynamos, another coupled to a 75-kw. dynamo, and a quantity of spare parts, seven Babcock & Wilcox boilers, two Worthington pumps, 6-ft. fan coupled to Belliss engine, feed heaters, &c. See our advertisement pages to-day.

Tunbridge Wells Telephones.—The Tunbridge Wells Town Council held a special meeting on Wednesday to consider a proposal whereby the National Telephone Co. would take over the municipal system. The Council has spent £25,000, and the company undertakes to pay this sum, and give an unlimited service for £6 per annum. The matter was deferred for a month to enable members to consider the terms of the agreement.

Piles.—An esteemed contemporary—"if you do not take it regularly, your duty to yourself demands that you should, &c."—is suffering with an attack of piles, thermo-piles! Its meteoriter informs the President of the North Staffordshire Institution of Mining and Mechanical Engineers that "electricians have never regarded the thermo-pile as a particularly efficient heat engine." If our memory does not deceive us this is a very different story to what it related some years ago concerning the Cox thermo-pile, exhibited at St. Albans, when the editor of our contemporary was in residence in that venerable Abbey town. But perhaps in those days "Meteor" had not blossomed forth into a full-blown electrician!

THE CENTRAL STATION ENGINEER.

Mr. A. P. Daybuegh, of Swansea, has been appointed assistant electrical engineer to the Dewsbury Corporation.

Oldham T.C. has increased the salary of the borough electrical engineer (Mr. Newington) from £375 to £400 per annum by annual increments of £25.

The borough electrical engineer, of Fulham, has tendered his resignation to the Council, to take effect as from March 25th next, unless his arrangements require an earlier departure.

Mr. David Dodd Cameron, eldest son of Mr. John Cameron, secretary and manager to the Blackpool and Fleetwood Electric Tramway Co., who is about to take up the position of station engineer to the Durban Corporation, was married at Hambleton, on October 29th, to Miss Mary E. Wright. The presents included a silver mounted dressing case from the employés of the Blackpool and Fleetwood Tramway Co.

Mr. E. F. Jones, of Wimbledon, has been appointed engineer-in-charge at Southport, at £117 per annum.

A presentation took place on Saturday last at the Leicester Corporation electric light works, on the departure from the town of Mr. G. Charlton, one of the engineers, who is leaving to take up an appointment of managing engineer at the electric light works at Banbury, Oxon. The presentation took the form of a non-magnetic stop-watch and a useful collection of technical books, and was made on behalf of the workmen and staff by Mr. Alfred Colson, M.I.C.E., M.I.E.E., who, in a few well chosen words, wished Mr. Charlton every success in his new undertaking.

CITY NOTES.

Brockie-Pell Arc Lamp, Ltd.

Lord Suffield presided on Wednesday at 60, Worship Street, E.C., over the annual meeting of the shareholders of the above company, and, in moving the adoption of the report, said they would agree that the accounts were the most satisfactory that the company had ever issued. The dividend of 3 per cent. was not so large as they desired, but it was the commencement of what they confidently hoped were better times. The large increase of over 40 per cent. in the sales showed that the business was steadily expanding, and although the competition owing to the cutting of prices by foreign and English firms had been very keen, yet the number of new orders, as well as many repeat orders, proved that the Brockie-Pell lamp had maintained its reputation, and that its special features were appreciated and valued by those engineers who had had experience of its working. It was true that the competition had compelled the company to reduce prices as there were still many buyers to whom first cost was the main object, and others who not having used Brockie-Pell lamps before, were satisfied with a lower standard of efficiency. But in order to meet this demand for a lower price lamp, the company had introduced a cheap type. These lamps, however, were not intended to supersede the standard pattern, which would still remain the lamp for all first-class work where lighting properties and a low rate of maintenance were the most essential requisites. Although the best lamps were more expensive than any other lamp on the market, yet the expense of maintenance was so very much less that it had been very much demanded by those who as he had stated, did not look at first cost. That had been the case with regard to the Westminster Electric Corporation who had installed a great many lamps in the West End of London. The new lamp would burn steadily, and would be a well-made lamp, but there would not be the extra finish on all parts. There was no doubt it would meet a want, and prove highly beneficial to the company's trading; as they knew there was an exceptional dullness of trade starting about the end of March last, and lasting about to the end of August. Some orders were put off indefinitely, and others were postponed until the late Autumn. He was glad to see that some of those had now been secured, and the orders received during the months of September and October had been most encouraging. Amongst the contracts of the past year, the most important was, of course, the Glasgow Exhibition. That had been brought to a satisfactory conclusion, and although a considerable sum of money was absorbed by it and a great deal of time taken up, the directors felt that the result had fully justified their action in taking on that work. It was admitted on all hands that the lighting of the Exhibition was an unqualified success, and there was no doubt that it had considerably influenced business. The Wolverhampton contract was not so large, but as Wolverhampton was situated in the centre of a large manufacturing district, the directors felt sure that here also the company's lamps would prove their suitability, and would increase the orders from that part of the country. Many would have noticed the large number of lamps which had been erected in the streets in Westminster during the past 18 months. These were Brockie-Pell, and about 950 were now lighted every evening. This was the largest installation of arc lamps in London, and the lighting of the district was very excellent. At Newcastle-on-Tyne the company had supplied and erected 200 Brockie-Pell lamps, and these had been suspended from the tramway poles. Smaller contracts had been completed at Brighton and Salford, where 115 and 106 respectively of the company's lamps had been erected in the same manner. Amongst many other orders were orders for lighting tramway carsheds, shops and warehouses in various parts of the country. Since June last over 100 lamps had been supplied for lighting the Bournemouth tramway road, and one of the most recent orders received had been for lamps at the forthcoming Durbar at Delhi. Since the conclusion of the war in South Africa, several satisfactory orders had been received from that country for important works now in progress, which they hoped would lead to a large and considerable business. He believed he might say that they would do a considerable business in that country. He considered that the prospects of the new year were at the present time decidedly hopeful.

Sir Dixon Hartland, in seconding the motion, endorsed what had been said by the chairman, and congratulated the shareholders that they were now in the category of dividend-paying companies. They could have paid a larger dividend than 3 per cent., but they thought it far better that they should not have a rising and falling dividend. The accounts clearly showed the position of affairs, and the gross profits were £500 larger than last year. The reason for this was the extra amount of business done. In the first year of the old company their sales were £10,000, in the second £17,000, and in the third £19,000, whilst in the first year's working of the new company they were £24,000, and now they had got £34,320. With regard to orders, in the first year's working of the old company they were 580, and they had increased each year to 831, 1,158, 1,647, and this year to 2,246, which showed that the company was progressing, and would progress more in the future than in the past. With regard to the agreement with the London and North-Western Railway Co., who paid royalties for any lamps they manufactured for their own use, they had recently received the first £100 from that company, and hoped in the future to get a much larger sum.

Considerable discussion, mainly of the complimentary character, followed.

Mr. Bengthell objected to the large sum put in the balance-sheet for patents and goodwill.

Mr. Brockie argued that so far from writing the patents down, they ought to be written up, for they were getting more valuable every day, and the patents were increasing in number.

The motion was adopted unanimously.

Monte Video Telephone Co.

Mr. Frank W. Jones presided at this company's meeting on October 30th, at Winchester House, E.C., and in moving the adoption of the report, said that the position and prospects of the company were favourable a year ago, and they had somewhat improved since. The receipts and the net results had been larger than in any previous year, and the latest reports from their manager in Monte Video showed that continued, if not rapid, progress might be expected in the future.

The Monte Video Harbour works were being actively pushed forward, and they would materially benefit general business. At their last meeting he indicated the probability of very considerable capital expenditure being required by new conditions in telephony and increasing business, and emphasised the necessity of preparing in advance for such demands. Fortunately during the past year they had not been called upon to incur any extraordinary outlay. The board had appreciated the necessity of avoiding, and had been very careful not to authorise, any hasty or ill-considered expenditure. Every effort had been made to increase and husband their resources for the time when they would be absolutely needed, and could be most advantageously expended, and they now had practically in cash a substantial reserve; besides that, they had for many years past made all payments on account of capital expenditure from the same fund. It was intended to continue building up their reserve. The necessity for that was constantly apparent, in fact, they knew that almost at any moment they might, to meet the requirements of the business, be called upon to make use of all their spare funds. The accounts compared favourably with those of the past five years, all of which had shown satisfactory results. The improvement for the year in net revenue was £323. It was proposed, subject to their approval, to pay the full dividend on the preferred shares, the usual dividend on the ordinary share capital, to place an additional £5,000 to reserve, and to carry forward the same amount as last year.

Mr. J. G. Le Merchant, seconded the motion. After some discussion the report was adopted.

Prospectus.—The Electromobile Co. has been before the public inviting applications for 20,000 £1 ordinary shares. The nominal capital is £50,000 in 45,000 ordinary and 5,000 deferred shares; 6,924 ordinary, and the whole of the deferred have been issued as fully paid. The company has been formed to establish electric charging depôts in London and elsewhere. An agreement has been made with Messrs. Greenwood & Batley, Ltd., who hold the British patents for electric motor carriages under the Contal system, to manufacture the chassis or under carriages for landaulettes, broughams, &c., and with the Gloucester Railway Carriage and Wagon Co., to make the bodies of the carriages. Mr. Theodore Chambers is the managing director of the company. The list closed last Saturday.

Electrolytic Alkali Co.—On Thursday last week the annual meeting of the Electrolytic Alkali Co. was held at the company's works at Middlewich. Mr. William Thomson (chairman), presided. A dividend at the rate of 7 per cent. on the preference shares was declared.

Tin Electro-Smelting Co.—The report of the directors was adopted at the third ordinary general meeting, held at the offices, 16, Tokenhouse Yard, E.C., on October 28th. The directors have declared an interim dividend of 7s. per share.

STOCKS AND SHARES.

Wednesday Evening.

Unexpected developments in the Consol and money markets have led to a pronounced improvement in the price of Goschens, which spurted sharply last Tuesday on account of the abundance of cash now available in Lombard Street. The fears of dearer money upon which it was ventured to cast incredulity a week ago have quite failed to justify themselves. Home Rails are jerkily better, losing one day part of the gain they made the previous afternoon, but the electric section is very little disturbed by these movements. In the telegraph department the fresh attention now being directed towards industrial securities by the general public is responsible for a further spurt in the Anglo-American varieties, but electricity supply shares do not participate at present in the favour with which purely investment shares are growing to be regarded.

Those who may wonder at the calmness and lack of activity prevailing in the supply section must not overlook the fact that the time is scarcely propitious to any particular attention being turned towards the shares. No dividends are expected just yet. No kind of anticipation of good things to come is present in the market; the winter has hardly made its presence felt sufficiently to cause the investor to look at electric lighting shares. But it may also be pointed out that the winter is usually the period of the year when animation comes to this department; foggy days and dark afternoons are ill winds which blow good to the electric companies, although it is to be hoped that the usual vagaries occasionally indulged in by the City concerns in past years will be checked this season. City of London shares are amongst the most active in this market, but the prices are unaltered this week—in fact, the share-list seldom presents such a clean sheet, so far as changes are concerned, as it does in our present issue. A new issue of 7 per cent. Preference shares is to be made by the Blackheath and Greenwich Co., at 21s. per £1 share.

Since we last quoted them, the best-known provincial lighting shares have undergone comparatively slight changes. Bournemouth and Poole Ordinary are 13, Oxfords 5½, Hove ¼ better at 8, and Folkestones 6¼, while Urban Ordinary and Preference both remain at 4. Central Electric Debenture at 108 is rather harder, and as regards other issues, Calcutta Electric at 7½ are well maintained, and Electric Lighting of Australia Preference receive a little attention at about 4, the 5 per cent. Debenture stock standing at 100¼. The Folkestone Co., it may be mentioned, is seeking powers to make a fresh issue of capital, and rumour points to the taking-over of the Hove Co. by the town authorities.

Amid all the strife and words, recriminations and correspondence which rages round the subject of London's electric traction, the stocks of the existing companies maintain a fairly stolid indifference. The presentation of the London County Council's urgency report exerted no influence over them. Waterloo and City stock has indeed risen a pair of points, but that is in connection with the better sentiment as regards Home Railways generally, this security more than either Central London's, or City and South London feeling the prevailing tone in the "Heavy" Railway market. City and South London is up a trifle, and a good sign is the hardening of the company's prior securities. The three Preference stocks are now quoted at 129½, 127½ and 125 for the 1891, 1896 and 1901 issues respectively. City Debenture stock stands at 116½, or a point less than that ruling for the Central London security of kindred character. Great Northern and City "A" Preference shares are 8 middle, *ex* the dividend of 3s. deducted last week. It seems probable that the first part of the new line will be ready for traffic soon after Christmas. The stocks of the two underground companies have slightly hardened, but the market remains apprehensive of the possible outcome of the County Council's latest proposals.

Other traction descriptions are irregular. British Electric Tractions remain dull. The market at the moment is anything but a good one; there is a strong tap running, and the company's supporters appear to be coy of supporting their shares. London United Preference are 11⅛, and the Debenture stock changes hands in the neighbourhood of 107, the Provisional certificates being quoted a point cheaper. A lot of vexatious trouble and annoyance is being caused in Preference dealings by reason of the fact that some of the shares carry about 6d. or 9d. per share less dividend than others, and the confusion grows daily worse confounded.

Anglo-Argentine Trams have strengthened to 4½, while Calcutta Trams are 7½. Only in these two is there any noticeable business being transacted outside the English group.

Anglo-American Telegraph Preferred and Ordinary stocks are both 1 per cent. higher on the week, and it is now said that there is nothing to fear from the wireless telegraph systems, although Marconi shares are 3¼ buyers. By the way, a quaint proposal is afoot for playing the next Anglo-American chess match by means of the new method of communication. Commercial Cable stock retains its new-found firmness, but there is no change to chronicle in Submarine certificates. Several stocks and shares in the telegraph list were marked *ex* dividend last week on the Stock Exchange account day, and allowing for the changes caused by these deductions, the market is very little changed. Great Northerns are down ¼, partly by reason of the questions asked the other day in the House of Commons, the answers to which, however, showed there was no cause whatever for uneasiness.

National Telephone Preferred and 3½ per cent. Debenture stocks are both a trifle easier, but beyond this the telephone department is lifeless. Henley's shares have spurted ¼, while Callender's, *ex* a dividend of 5s., are nominally twice the amount down. As regards prior securities, India-Rubber Debenture, with a rise of 1, has risen to a small premium.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1899.	1900.	1901.	Closing Quotations Oct. 29th.	Closing Quotations Nov. 5th.	Business done week ended Nov. 5th, 1902. Highest	Lowest.
67,100	African Direct Telegraph, 4 % Debs.	100	..	..	..	98 —102	98 —102	..	..
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	..	..	..	3½— 4½	3½— 4½	..	..
119,700£	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	..	..	..	70 — 80	70 — 80	..	..
788,840	Anglo-American Telegraph	Stock	7s/6	3½%	6½s.	50 — 53	51 — 54	53¼	51
3,105,580	Do. do. do. 6 % Pref.	Stock	6 %	6 %	6 %	94 — 96	95 — 97	96½	95
3,105,580	Do. do. do. Deferred	Stock	£1 7s.	5s. %	2s.	8¾— 9¼	8¾— 9¼	9¼	8½
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	5 %	5 %	3¾— 4¼	3¾— 4¼	..	..
13,333,300$	Commercial Cable	$100	8 %	8 %	8 %	178 —188	178 —188	..	..
1,841,209	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock				94 — 96	94 — 96	96½	94½
16,000	Cuba Telegraph	10	7 %	4½%	4 %	5½— 6½	5½— 6½ xd	..	..
6,000	Do. 10 % Pref.	10				13 — 14	12½— 13½ xd	..	..
12,981	Direct Spanish Telegraph	5	4 %	4 %	4 %	2½— 3½	2½— 3½	..	..
6,000	Do. do. 10 % Cum. Pref.	5				7 — 8	7 — 8	..	..
60,710£	Direct United States Cable	20	3½%	3½%	3½%	10½— 11	10½— 11	10¾	10½
96,300	Direct West India Cable, 4½% Reg. Deb., within Nos. 1 to 1,200, Red.	100				100 —103	100 —103	..	..
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	124 —129	125½—125	126	124
1,955,565	Do. 3½ % Pref. Stock	100	..	..	..	89 — 92	90½— 92	..	..
1,584,645	Do. 4 % Mort. Deb. Stock Red.	Stock	..	..	..	106 —109	104 —107 xd	105	104
300,000	Eastern Extension, Australasia, and China Telegraph	10	7 %	7 %	7 %	12 — 12½	12 — 12½	12¾	12½
320,000£	Do. 4 % Deb. Stock	Stock				107 —110	107 —110	..	..
300,000	Eastern & South African Tele., 4% Mt. Db., Nos. 1 to 3,000, red. 1909	100	5½%	..	..	99 —102	99 —102	..	..
200,000£	Do. do. 4 % Reg. Mort. Debs. (Mauritius Sub.) 1 to 8,000	25				101 —104 %	99 —102	100¼	..
180,227	Globe Telegraph and Trust	10	5½%	5½%	5½%	9½— 10	9½— 10 xd	9¾	9½
180,042	Do. do. 6 % Pref.	10				13½— 14	13½ 13¾ xd	13¾	13½
150,000	Great Northern Telegraph, of Copenhagen	10	12½%	15 %	15 %	27½ — 28½	27 — 29	28	..
70,000	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	..	..	..	100 —108	100 —108	..	..
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	39 — 40	38 — 42 xd	..	..
100,000£	London Plating-Brazilian Telegraph, 6 % Debs.	100	..	..	..	101 —105	101 —105	..	..
72,680	Montevideo Telephone, Ltd., Ord. Nos. 1 to 72,680	1	3½%	..	..	½— ¾	½— ¾	..	..
86,492	Do. do. 5 % Pref., Nos. 1 to 86,492	1	5 %	..	..	½— 1	½— 1	..	..
1,983,333	National Telephone, Pref. Stock	100	5 %	5 %	5 %	93 — 95	92 — 94	94	92½
1,966,667	Do. do. Def. Stock	100	..	60	64 xd	56 — 58	56 — 58	56¾	..
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	12½— 13½	12½— 13½	13⅛	12½
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	11½— 12½	11½— 12½	..	..
250,000	Do. do. 5 % Non-cum. 3rd. Pref., 1 to 250,000	5	5 %	5 %	5 %	4¼— 5⅛	4½— 5⅛	5⅛	4⅛
2,000,000£	Do. do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	96 — 99	95 — 98	96	..
600,000	Do. do. 4 % Deb. Stock Red.	100	..	4 %	4 %	102 —106	102 —106	..	..
171,504	Oriental Telephone and Elec. Nos. 1 to 171,504, fully paid	1	5 %	6 %	6 %	½— 1	½— 1 xd	..	..
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000	100	..	..	..	99 —102	99 —102	..	..
11,899	Reuter's	8	5 %	5 %	5 %	6½— 7½	6½— 7½	6⅝	..
3,808	Submarine Cables Trust	Cert.				110 —120	110 —120	..	..
58,000	United River Plate Telephone	5	7 %	7 %	7 %	4½— 5½	4½— 5½	..	..
40,000	Do. do. 5 % Cum. Pref., Nos. 1 to 40,000	5	..	..	..	4½— 5	4½— 5	..	..
179,947£	Do. do. 5 % Debs.	Stock	..	..	..	102 —105	102 —105	..	..
15,609	West African Telegraph, Shares	10	..	..	..	3½— 4½	3 — 4	..	..
30,008	West Coast of America, Nos. 1 to 30,000 and 53,001 to 53,008	2½	..	..	..	0 — ½	0 — ½	..	..
150,000£	Do. do. 4% Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	..	..	..	98 —101	98 —101	..	..
267,930	Western Telegraph, Ltd., Nos. 1 to 267,930	10	7 %	7 %	7 %	11⅜— 12½	12½— 12	11⅝	11½
75,000£	Do. do. 5 % Debs. 2nd series, 1900	100	..	..	..	102 —105	102 —105	..	..
400,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	99 —102	99 —102	..	..
88,321	West India and Panama Telegraph	10	6%	4%	..	½— ¾	½— ¾	⅝	½
34,563	Do. do. do. 6 % Cum. 1st Pref.	10	..	..	..	4½— 5	4½— 5	4⅝	..
4,689	Do. do. do. 6 % Cum. 2nd Pref.	10	..	..	..	3 — 4	3 — 4	..	..
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	..	..	..	100 —103	100 —103	..	..

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

20,000	British Aluminium 7 % Cum. Pref.	10	..	5½%	..	3½— 4½	3 — 4	..	..
300,000£	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock				83 — 88	83 — 88	..	..
100,000	British Electric Traction	10	8 %	9 %	9 %	13 — 13½	12¾— 13½	13½	12¾
100,000	Do. do. 6 % Cum. Pref.	10	..	..	..	12½— 12¾	12 — 12½	12½	12½
600,000£	Do. do. 5 % Perpetual Debenture Stock	Stock				124 —127	124 —127	126½	125½
100,000	British Insulated Wire Ord.	5	20 %	15 %	10 %	7½— 8½	7½— 8½	..	..
100,000	Do. do. 6 % Cum. Pref.	5	..	..	..	5½— 6	5½— 6	6	..
50,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	..	..	..	103 —106	103 —106	..	..
50,000	¶Browett, Lindley & Co. (1899), Ord.	£1	..	8 %	..	13s. to 15s.	13s. to 15s.	..	..
50,000	¶ Do. do. 6 % Cum. Pref.	£1	..	6 %	..	16s. to 16/6	16/6 to 17s.	..	..
105,731	Brush Electrical Engineering, Ord., 1 to 105,731	2	5%	5 %	Nil	¾— 1½	¾— 1	..	..
150,000	Do. do. Non-cum. 6 % Pref.	2	6 %	6 %	3 %	1 — 1½	1 — 1½	..	..
125,000£	Do. do. 4½ % Perp. Deb. Stock	Stock	..	..	..	100 —103	100 —103	..	..
125,000£	Do. do. 4½ % Perp. 2nd Deb. Stock	Stock	..	..	..	94 — 99	93 — 98	..	..
35,000	Callender's Cable Construction shares	5	15 %	15 %	20 %	15¾— 16½	15 — 16 xd	15¾	..
40,000	Do. do. do. 5 % Cum. Pref.	5	..	..	..	5¾— 6¼	5¾— 6¼	..	..
90,000£	Do. do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	..	..	..	109 —113	109 —113	..	..
1,860,014	Central London Railway, Ord. Stock	Stock	..	..	4 %	108 —111	108 —111	109	108
494,093	Do. do. 4 % Pref. Stock	Stock	..	..	4 %	107 —110	107 —110	109	107¾
494,993	Do. do. Def. do.	Stock	..	..	4 %	108 —111	108 —111	108⅝	108⅜
1,330,000	City and South London Railway	Stock	1½%	1½%	2 %	71 — 73	73 — 75	74	73
85,000	Crompton & Co., Nos. 1 to 85,000	3	7½%	8 %	7½%	2½— 2¾	2½— 2¾	2⅝	..
100,000£	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 red.	..	..	..	..	101 —106 %	101 —106 %	..	..
99,261	Edison & Swan United Elec. Light, "A" shares, £3 paid, 1 to 99,261	5	6 %	2½%	..	½— ¾	½— ¾	..	..
17,139	Do. do. "A" shares, 01—017,139	5	6 %	2½%	..	1½— 2½	1½— 2½	..	..
344,023£	Do. do. 4 % Deb. Stock Red.	100	..	..	..	74 — 78	74 — 78	..	..
100,000£	Do. do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	..	..	..	77 — 82	77 — 82	..	..
112,100	Electric Construction, 1 to 112,100	2	6 %	6 %	6 %	1½— 2	1½— 2	1½	1⅜
31,390	Do. do. 7 % Cum. Pref., 1 to 31,390	2	..	..	..	2½— 2⅝	2½— 2⅝	..	..
182,500£	Do. do. 4 % Perp. 1st Mort. Deb. Stock	Stock	..	..	..	99 —102	99 —102	..	..
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	..	5 %	5 %	10 — 10½	10 — 10½	..	..
200,000	Do. do. 4 % Mort. Deb.	Stock	..	..	..	99 —102	99 —102	..	..
35,000	Henley's (W. T.) Telegraph Works, Ord.	5	15 %	20 %	20 %	16 — 17	16½— 17½	17½	17
35,000	Do. do. 4½ % Pref.	5	4½%	4½%	..	5½— 5⅝	5½— 5⅝	..	..
48,050	Do. do. 4½ Mort. Deb. Stock	Stock	..	..	..	109 —113	109 —113	..	..
50,000	India-Rubber, Gutta-Percha & Telegraph Works	10	10 %	10 %	..	20½— 21½	20½— 21½	..	..
300,000£	Do. do. do. 4 % 1st Mort. Deb.	100	..	..	..	99 —102	100 —103	..	..
37,500	†Liverpool Overhead Railway, Ord.	10	3⅛%	3⅛%	1¼%	4⅜— 5	4⅛— 5⅛	..	..
10,000	† Do. do. Pref. £10 paid	10	5 %	..	..	10 — 10¾	9¾— 10¾	..	..
7,500	Parker (Thomas), Ltd., Ord., Nos. 1 to 7,500	10	..	..	..	14½— 15½	14⅛— 15½	..	..
	§Rosling & Fynn 6 % Cum. Pref.	£1	..	6 %	..	19/0 to 20/0	..	..	..
37,350	Telegraph Construction and Maintenance	12	15 %	17½%	20 %	37 — 40	37 — 40	39½	38⅜
150,000£	¶ Do. do. 4 % Deb. Bds., Nos. 1 to 1,500 Red. 1909	100				102 —105	102 —105	..	..
640,000£	Waterloo & City Railway, Ord. Stock	100	3 %	3 %	3 %	90 — 95	91 — 94	..	..

† Quotations on Liverpool Stock Exchange.
§ From Bradford Share List.

‡ Unless otherwise stated all shares are fully paid.
¶ From Manchester Share List.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Consolidated Telephone Construction and Maintenance, ⅛—⅜.
National Electric Free Wiring, ½—1.

Oldham, Ashton, and Hyde Electric (£10 pd.), Ord., 13—14.
Do. do. Pref. (£10 pd.), 10—11

Bank rate of discount 4 per cent. (October 2nd, 1902).

SHARE LIST OF ELECTRICAL COMPANIES (*continued*).—ELECTRICITY SUPPLY COMPANIES.

Present issue.	NAME.	Stock or Share.	Dividends for the last three years. 1899.	1900.	1901.	Closing Quotations Oct. 29th.	Closing Quotations Nov. 5th.	Business done week ended Nov. 5th, 1902. Highest.	Lowest.
		‡							
100,000	Blackheath and Greenwich Dist. Electric Light, Ord.	1	..	..	..	⅜ — ⅝	⅜ — ⅝	..	..
100,000	Do. 4½% 1st Deb. Stock, Prov. Certs.	100	..	..	..	105 —108	106 —109	..	..
20,000	Brompton & Kensington Electric Light Sup., Ord., 1 to 20,000	5	6 %	6 %	8 %	10¼— 10⅝	10¼— 10⅝	..	..
20,000	Do. do. 7 % Cum. Pref.	5	..	..	..	10¼— 10⅝	10¼— 10⅝	..	..
50,000	Charing Cross and Strand Electricity Supply	5	9 %	9 %	10 %	9 — 9¼	9 — 9¼	..	..
70,000	Do. do. do. 4½% Cum. Pref.	5	..	..	..	5¾— 6	5¾— 6	5⅝	5
40,000	Do. do. "City Undertaking" 4½% Cum. Pref.	5	..	..	..	4¾— 5¼	4¾— 5¼	..	..
250,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	105 —107	105 —107	106½	..
44,436	*Chelsea Electricity Supply, Ord.	5	6 %	5½%	4 %	5¾— 6	5¾— 6	..	..
150,000£	Do. do. % Deb. Stock Red.	Stock	..	..	..	109 —112	109 —112	..	..
70,595	City of London Electric Lighting, Ord. 40,001—110,595	10	4 %	0 %	5 %	10 — 11	10 — 11	..	..
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	..	13¾— 14¼	13¾— 14¼	14	..
400,000£	Do. 5 % Deb. Stock, Scrip. (iss. at 115) all paid	..	..	..	..	123 —128	123 —128	..	..
300,000	Do. 4½% 2nd Deb. Stock, Prov. Certs., all paid	100	..	..	..	104 —107	104 —107	..	..
40,080	County of London & Brush Prov. Electric Lighting, Ord. 1—40,000	10	4 %	4 %	4 %	8¾— 9¼	8¾— 9¼	..	..
20,000	Do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	..	11¾— 12¼	11¾— 12¼	..	..
400,000£	Do. do. 4½% Deb. Stock, Prov. Certs. (all paid) Red	..	..	..	..	110 —113	110 —113	110½	..
50,000	Edmundson's Electric Corporation, Ord. Shares	5	6 %	7 %	7 %	6 — 6⅜	6 — 6⅜	..	..
30,000	Do. do. 6 % Cum. Pref.	..	..	..	..	6 — 6⅜	6 — 6⅜ xd	..	..
140,000	Do. do. 4½% 1st Mort. Deb. Stock	100	..	..	..	107 —110	107 —110	..	..
21,000	Kensington and Knightsbridge Electric, Ord.	5	11 %	12 %	10 %	10 — 11	10 — 11	..	..
90,000	Do. do. do. 4 % Debenture Stock	Stock	..	..	..	101 —104	101 —104	..	..
110,000	London Electric Supply Corporation, Limited, Ord.	3	..	..	..	1⅜— 2⅛	1⅜— 2⅛	..	..
49,840	Do. do. do. 6 % Pref.	5	..	..	..	4¾— 5¼	4¾— 5¼	5	..
250,000£	Do. do. do. 4 % 1st Mort. Deb. Stock Red	Stock	..	..	..	96 — 99	96 — 99	98	..
100,000	Metropolitan Electric Supply, 1 to 100,000	10	5 %	6 %	6½%	15½— 16½	15½— 16½	16½	16⅛
220,000£	Do. do. 4½% 1st Mort. Deb. Stock	..	..	..	..	110 —115	110 —115	..	..
250,000£	Do. do. 3½% Mort. Deb. Stock Red	Stock	..	..	..	99 —102	99 —102	..	..
10,852	Notting Hill Electric Lighting	10	7 %	7 %	6 %	13¾— 14½	13¾— 14½	..	..
40,000	St. James' and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	14¾— 15⅜	14¾— 15⅜	..	..
20,000	Do. do. do. 7 % Pref. 20,081 to 40,080	5	7 %	7 %	7 %	8¾— 9⅛	8¾— 9⅛	..	..
150,000£	Do. do. do. 3½% Deb. Stock Red	100	..	..	..	98 —101	98 —101	..	..
12,000	Smithfield Markets Electric Supply, Ord.	5	..	..	..	1⅞— 2⅛	1⅞— 2⅛	..	..
50,000£	Do. do. 4% Deb.	100	..	..	..	80 — 90	80 — 90	..	..
65,000	South London Electricity Supply, Ord.	5	..	..	..	2⅞— 3⅛	2⅞— 3⅛	3 1/16	..
30,000	Urban Electric Supply, Ord., £4 pd.	5	..	..	..	3⅞— 4⅛	..	..	..
30,000	Do. do. 5 % Cum. Pref., £4 pd.	5	..	..	..	3⅞— 4⅛	..	4 1/16	..
110,000	Westminster Electric Supply, Ord.	5	13 %	10½%	10½%	11½— 12⅝	11½— 12⅝	12⅝	..
28,141	Do. do. 5 % Cum. Pref.	5	..	..	..	6 — 6⅜	6 — 6⅜	6⅜	6

* Subject to Founders Shares. ‡ Unless otherwise stated all shares are fully paid.

MARKET QUOTATIONS, Wednesday, November 5th.

CHEMICALS, &c.		This week.	Last week.	Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	5/-	..
a ,, Nitric	per cwt.	22/-	22/-	..
a ,, Oxalic	per cwt.	32/-	32/-	..
a ,, Sulphuric	per cwt.	5/6	5/6	..
a Ammoniac, Sal	per cwt.	42/-	42/-	..
a Ammonia, Muriate (crystal)	per ton	£33 10	£33 10	..
a ,, ,,	per ton	£30	£30	..
a Bleaching powder	per ton	£4 10	£4 10	..
a Bisulphide of Carbon	per ton	£15	£15	..
a Borax	per ton	£13	£13	..
a Bensole (90 %)	per gal.	7/-	7/-	..
c ,, (50/90 %)	per gal.	5/6	5/6	..
a Copper Sulphate	per ton	£19	£19	..
a Lead, Nitrate	per ton	£24	£24	..
a ,, White Sugar	per ton	£31	£31	..
a ,, Peroxide	per ton	£27 10	£27 10	..
a Methylated Spirit	per gal.	2/6	2/6	..
a Naphtha, Solvent (90% at 160° C.)	per gal.	5/6	5/6	..
a Potash, Bichromate, in casks	per lb.	3d.	3d.	..
a ,, Caustic (75/80%)	per ton	£24	£24	..
a ,, Bisulphate	per ton	£35	£35	..
a Shellac	per cwt.	130/-	130/-	..
a Sulphate of Magnesia	per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers	per ton	£6 5	£6 5	..
a ,, Recovered	per ton	£5 10	£5 10	..
a ,, Lump	per ton	£5	£5	..
a Soda, Caustic (white 70 %)	per ton	£10 15	£10 15	..
a ,, Crystals	per ton	£3	£3	..
a ,, Bichromate, casks	per lb.	2½d.	2½d.	..

METALS, &c.				
b Aluminium Ingots, in ton lots	per ton	£148	£148	..
b ,, Wire, in ton lots	per ton	£224	£224	..
b ,, Sheet, in ton lots	per ton	£191	£191	..
p Babbitt's metal ingots	per ton	£40 to £150	£40 to £140	£10 dec.
c Brass (rolled metal 2" to 12") basis	per lb.	7¼d.	6¾d.	¼d. dec.
c ,, Tube (brazed)	per lb.	8¾d.	8¾d.	¼d. dec.
c ,, ,, (solid drawn)	per lb.	6¾d.	7d.	¼d. dec.
c ,, Wire, basis	per lb.	6¾d.	7d.	¼d. dec.
c Copper Tubes (brazed)	per lb.	8¾d.	8¾d.	..
c ,, ,, (solid drawn)	per lb.	9d.	9d.	..
g Copper Bars (best selected	per ton	£67	£67	..

METALS, &c. (*continu*		This week.	Last week.	Inc. or Dec.
g Copper Sheet	per ton	£67	£67	..
g ,, Rod	per ton	£67	£67	..
e ,, (Electrolytic) Bars	per ton	£65	£65	..
e ,, ,, Sheets	per ton	£74	£74	..
e ,, ,, Rod	per ton	£65	£65	..
e ,, ,, H.C. Wire	per lb.	7¼d.	7¼d.	..
f Ebonite Rod	per lb.	3/-	3/-	..
f ,, Sheet	per lb.	5/-	5/-	..
n German Silver Wire	per lb.	1/4½	1/4½	..
h Gutta-percha fine	per lb.	8/-	8/-	..
h India-rubber, Para fine	per lb.	3/1½ to 3/4½	3/1 to 3/4	½d. inc.
i Iron, Charcoal Sheets	per ton	£18	£18	..
i ,, Pig (Cleveland warrants)	per ton	51/3½	52/0½	9d. dec.
i ,, Forgings, according to size	per ton	From £11	From £11	..
i ,, Scrap, heavy	per ton	47/6 to 50/-	47/6 to 50/-	..
i ,, Wire, galvanised No. 8	per ton	£9 15	£9 15	..
g Lead, English Ingot	per ton	£11	£10 17 6 to £11	inc.
g ,, ,, Sheet	per ton	£13	£13	..
m Manganin Wire No. 28	per lb.	8/-	8/-	..
g Mercury	per bot.	£8 15	£8 15	..
d Mica (in original cases) small	per lb.	3d. to 9d.	3d. to 9d.	..
d ,, ,, ,, medium	per lb.	1/9 to 2/9	1/9 to 2/9	..
d ,, ,, ,, large	per lb.	3/3 to 7/3	3/3 to 7/3	..
p Phosphor Bronze, plain castings	per lb.	11½d. to 1/2	11½d. to 1/2	..
p ,, rolled bars & rods	per lb.	1/- to 1/3	1/- to 1/3	..
p ,, ,, strip & sheet	per lb.	From 1/2	From 1/2	..
o Platinum	per oz.	£4	£4	..
p Silicium Bronze Wire	per lb.	9d. to 1/-	9d. to 1/-	..
i Stee, Magnet, acc'd'g to desc'p'n	per ton	£58	£58	..
i ,, ,, in bars	per ton	From £15 to £40	to £40	..
g Tin, Block	per ton	£120 10 to £121 10	£120 10 to £121 10	..
g ,, Foil	per lb.	1/6	1/6	..
n ,, Wire, Nos. 1 to 16	per lb.	1/6½	1/6½	..
p White Anti-friction Metals—				
"White Ant" brand	per ton	£36 to £60	£36 to £60	..
j Yarns, 2/10s Grey Cotton, on sp'ls	per lb.	7d.	7d.	..
j ,, 6 lea. Flax	per lb.	5¾d.	5¾d.	..
j ,, 3 ply 10 lbs. Russian	per lb.	4½d.	4½d.	..
j ,, 10 lbs. Russian, single	per lb.	4¼d.	4¼d.	..
j ,, 180 lbs. Jute rove	per ton	£11 11	£11 11	..
k Zinc, Sh't (Vieille Montagne bnd.)	per ton	£23	£23	..

Quotations supplied by
a Messrs. G. Boor & Co.
b The British Aluminium Co., Ltd.
c Messrs. Thos. Bolton & Sons., Ltd.
d Messrs. F. Wiggins & Sons.
e Messrs. Frederick Smith & Co.

Quotations supplied by
f India-Rubber, G.P. and Teleg. Works
g Messrs. James & Shakspeare. [Co., Ltd.
h Messrs. Edward Till & Co.
i Messrs. Bolling & Lowe.
j Messrs. Walter H. Hindley & Co., Ltd.

Quotations supplied by
k Messrs. Morris Ashby, Limited.
m Messrs. W. T. Glover & Co., Ltd.
n Messrs. P. Ormiston & Sons.
o Messrs. Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Company, Ltd.

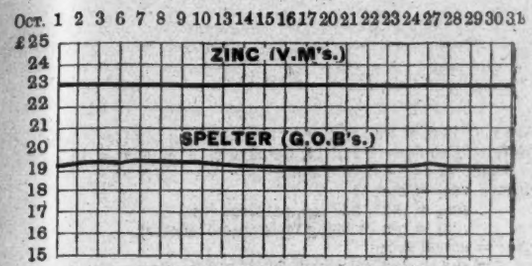
TRAFFIC RECEIPTS.

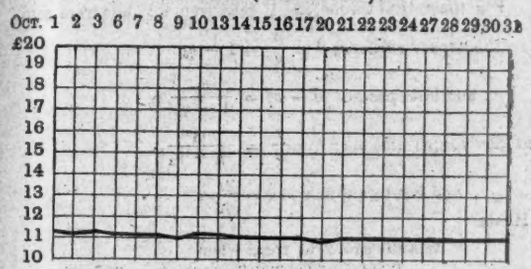
Company.	Week ending	Receipts for the week. Am'nt.	Inc. or dec.*	Total to date. Am'nt.	Inc. or dec.*	Miles open. This year.	Last year
		£	£	£	£		
Blackburn Corp. Trys.	Oct. 25	734	+ 48	23,244	+ 3,607	12½	12½
Blackpool and Fleetwood	Nov. 1	268	+ 10	19,384	— 277	7½	7½
Bristol Trys. & Car. Co.	Oct. 31	4,411	+469	—	—	28	28
British Elec. Trac. Co.:—							
Devonport	,, 24	441	+ 59	18,551	+ 1,121	5	5
Dudley—Stourbridge	,, 24	714	+ 15	32,469	+ 3,806	18½	18½
Gateshead	,, 24	302	+246	13,134	+ 6,069	10½	9½
Gravesend—Northfleet	,, 24	197	—	2,610	—	3½	—
Greenock—Pt. Glasgow	,, 24	449	+180	21,616	+12,747	7½	7½
Hartlepool	,, 24	213	— 18	10,949	+ 1,089	6½	4½
Kidderminster	,, 24	107	— 9	5,890	+ 19	4½	4½
Merthyr	,, 24	181	— 9	8,641	— 1,578	8	8
Middleton	,, 24	253	—	9,359	—	5½	—
Oldham—Ashton	,, 24	552	+ 45	22,934	+ 1,210	8	8
Poole	,, 24	247	+ 16	11,236	— 115	3½	3½
Potteries	,, 24	1,593	+170	68,338	+ 8,164	28½	28½
Rothesay	,, 24	48	+ 21	1,644	+ 594	—	—
B.E.T. Co. (*continued*)—							
Southport	Oct. 24	941	+ 96	11,160	+ 3,929	5½	5½
South Staffordshire	,, 24	716	— 94	32,524	— 979	21½	22½
Swansea	,, 24	454	+ 4	10,367	+ 1,276	5½	5½
Taunton	,, 24	52	— 12	2 880	— 313	1½	—
Tynemouth	,, 24	247	+ 45	12,948	+ 1,718	3½	3½
Weston-super-Mare	,, 22	47	—	15,382	—	2½	—
Wolverhampton Dist.	,, 24	302	+184	8,852	+ 5,745	10½	2½
Central London Railway	Nov. 1	7,155	+526	117,065	+10,062	6	6
City and S. London Ry.	,, 2	3,284	+1,178	52,941	+18,275	4½	4½
Doncaster Corp. Trys.	..	—	—	—	—	3½	—
Dover Corporation Trys.	,, 1	201	+ 4	9,619	+ 53	3	3
Dublin United Trys.	Oct. 31	4,473	+175	88,708	+ 1,719	46	46
East Ham Tramways	Nov. 1	455	+110	9,483	+ 1,626	5	4½
Glasgow Corp. Trys.	,, 1	12,760	—435	269,421	—12,625	67½	48
Liverpool Overhead Ry.	,, 2	1,527	+ 82	28,968	— 967	6½	6½
Newcastle Corp. Trys.	,, 1	3,061	—	—	—	35	—
Sunderland Corp. Trys.	,, 5	1,060	+ 37	37,637	+ 2,699	17½	17½

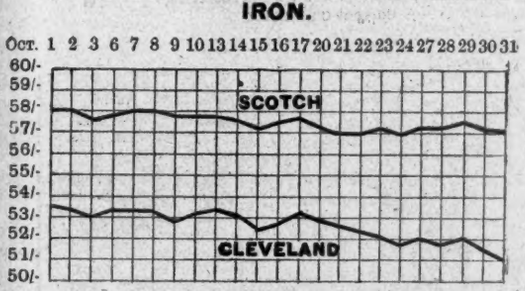
* Compared with the corresponding period of 1901.

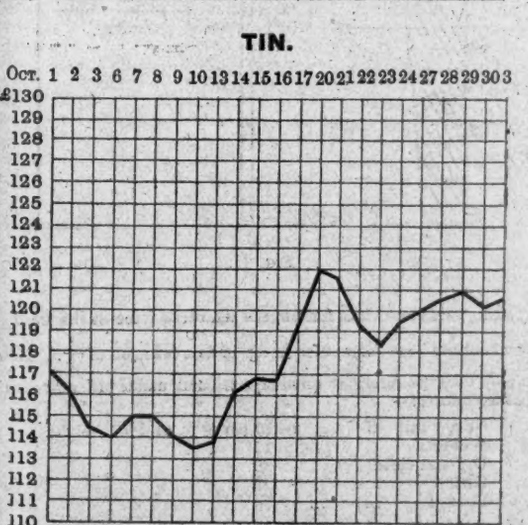
METAL MARKET.

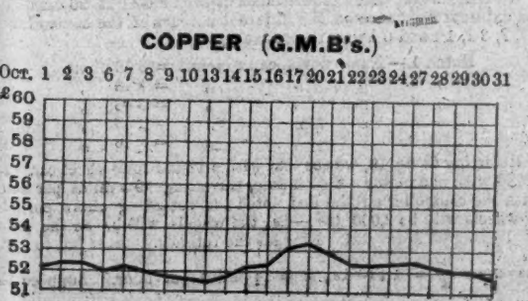
Fluctuations in October.











INSTITUTION OF ELECTRICAL ENGINEERS.

NOTES ON THE TESTING OF TRAMWAY MOTORS, AND AN INVESTIGATION INTO THEIR CHARACTERISTIC PROPERTIES.

By Michael B. Field, Member, A.M.Inst.C.E.

(*Paper read at Glasgow, May 13th, 1902.*)

(*Continued from page 760.*)

To obtain the correct temperatures at the end of the heat run the author has found it best to employ bent thermometers, as shown in fig. 8. Two holes are drilled through the motor case, through one of which a thermometer can, immdiately after the test is finished, be

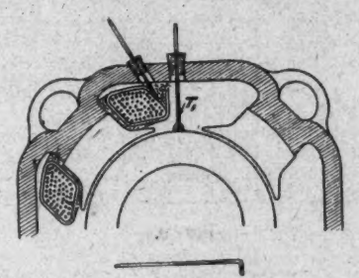


Fig. 8.

dropped down on to the surface of the armature. The bulb of the thermometer is protected by a cork hood to thermally insulate it. The second thermometer is packed into a pocket formed in the side of the field coil so that its bulb is lying up against the winding, as shown in fig. 8.

With this arrangement the two thermometers are gradually rising towards their final temperature throughout the test, upon the conclusion of which no time need be lost in bringing T down on to the surface of the armature. A short interval of time must, however, elapse before the final temperature can be recorded, especially if a cold thermometer be laid upon the commutator to determine the rise of temperature of the same.

If, however, time readings be taken from the finish of the test until the maximum temperatures are recorded, and then for an equal length of time further (during which the motors are cooling), a correction for the cooling-off during the first interval can readily be arrived at.

If the motors have to be opened up before the thermometers can be applied to the surfaces it will be found that usually 15 minutes elapse, and often a considerably longer period, before the final temperatures are recorded, during which time the motors will have cooled to a considerable extent.

In making this test care should be taken that there is no excessive pressure between brushes and commutator, also that there is no sparking which can be avoided—that is, which is not inherent in the motor, *e.g.*, such as due to unfair vibration of the frame; for an abnormal commutator temperature will naturally heat the air inside the motor case to a greater extent, and cause both armature and field coils to show a higher final temperature than otherwise.*

By making a series of such tests at different current inputs, in each case allowing the test to continue till 75° C. rise is reached at some part of the motor, the thermal characteristic can be obtained. It often happens that at the upper part of the curve the temperature is governed by the armature, and at the lower part by the field coil. As an example, fig. 9 shows the thermal characteristic for the well-known, though somewhat old-fashioned, G.E. 58 motor.

Before removing the motors from the testing frame, it will be found a good plan to try them for flashing by connecting them up to a rheostatic brake controller, running them at a high speed, and then applying the brake (*i.e.*, short-circuiting the motors after reversing the field connections, under which circumstances they act as generators, generating current in the closed circuit.) A comparison of different motors from this point of view is of great importance.

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* The following figures are interesting as bearing on the subject. The same motor was tested twice at exactly the same load. In the first case the brushes were sparking badly and the friction was excessive. The increased rise of temperature at all parts could therefore only have been due to the great temperature rise of the commutator.

Test I. *One hour's run:*—

Final temperature of armature	68° C.	Rise	49° C.
" " field coils	70° C.	"	51° C.
" " commutator	111° C.	"	92° C.
" " atmosphere	19° C.		

Test II. *Same motor, same load, one hour's run:*—

Final temperature of armature	68° C.	Rise	48° C.
" " field coils	67·5° C.	"	47·5° C.
" " commutator	63° C.	"	43° C.
" " atmosphere	20° C.		

In carrying out this test an interesting phenomenon will be noticed, viz., that if the brake be suddenly applied to the motors, while running at a high speed, they will quickly stop, and then run round in the reverse direction for a few revolutions. The reason of this, most probably, is that, owing to the large self-induction

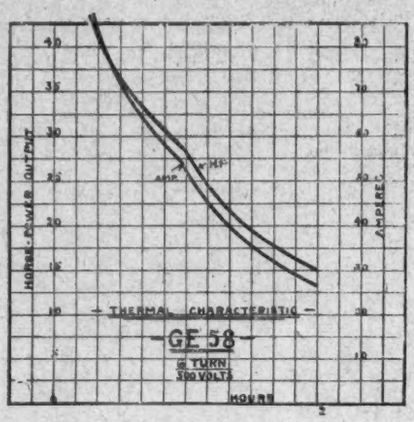

Fig. 9.

and small resistance of the short-circuited motors, the current generated has not died away by the time the motors have been brought to a standstill. This current still circulates, then, round the circuit as if supplied from an outside source, and the field magnets being reversed, the direction of rotation is reversed. There is, however, no further tendency to reversal of rotation, for the motors running in the reversed direction will not at any speed whatever generate current as generators unless their fields be again reversed.

Before leaving the subject of rheostatic braking the following considerations will be found of interest and importance:—

The E.M.F. generated in the armature of the motor working as a generator will be proportional to the speed n multiplied by some function of the current representing magnetic flux. We have in fact:—

$$v = cR = nf(c) \text{ or } \frac{n}{R} = \frac{c}{f(c)} = \phi(c).$$

Now, from the volt-ampere characteristic, which is easily constructed for any given speed from the figures tabulated, it is a simple matter to obtain the value of $\frac{n}{R}$ corresponding to any current strength.

Fig. 10 shows the volt-ampere characteristic for motor P, and the ampere — $\frac{n}{R}$ curve for two motors connected in parallel as in fig. 11. (See note 2 at end.)

It is to be noted that when the motors are being supplied with power from an external source the tractive effort at the tread of

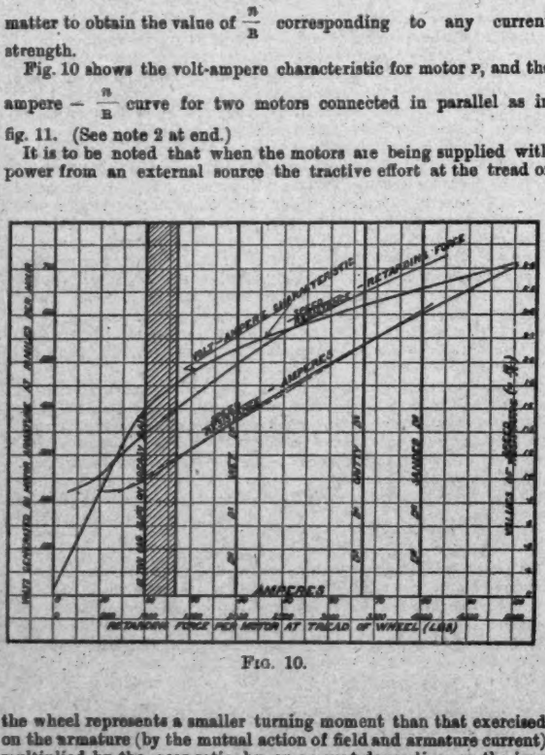

Fig. 10.

the wheel represents a smaller turning moment than that exercised on the armature (by the mutual action of field and armature current) multiplied by the gear ratio, by an amount depending on the iron and gear losses. When, however, the motors are short-circuited and acting as brakes the torque exerted by the rail on the car wheel must be greater than the retarding torque on the armature multiplied by the gear ratio, by approximately the same amount.

This means that a larger current can be put through the motors when supplying them with power, without skidding the wheels, than can circulate when the motors are themselves generating current to brake the car.

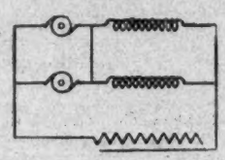

Fig. 11.

We may look at this matter in the following light:—

Referring to figs. 11 and 12, we have $\eta_1 + \eta_2 + \eta_3 = 1$;

also vc = input into motor

Hence $vc\eta_1$ = output

$vc\eta_2$ = gear, friction, and iron loss

$vc\eta_3 = c^2R$ (R being resistance of motor).

If n = actual speed

v = the theoretical speed, *i.e.*, if R were zero

T = actual torque at tread of wheel, motor being supplied with a current c

τ = theoretical torque, *i.e.*, if gear, iron, &c., loss were zero.

Then the "speed efficiency" or $\frac{n}{v} = 1 - \eta_3$,

$$\text{and lost speed or } (v - n) = \frac{\eta_3}{1 - \eta_3} \cdot n,$$

also the "torque efficiency" or $\frac{T}{\tau} = \frac{\eta_1}{\eta_1 + \eta_2}$,

$$\text{and lost torque or } \tau - T = \frac{\eta_2}{\eta_1} \cdot T.$$

Hence

$$\frac{\text{Retarding force at tread when generating current } c}{\text{Tractive effort at tread when receiving current } c \text{ as motor}} = \frac{\eta_1 + 2\eta_2}{\eta_1}.$$

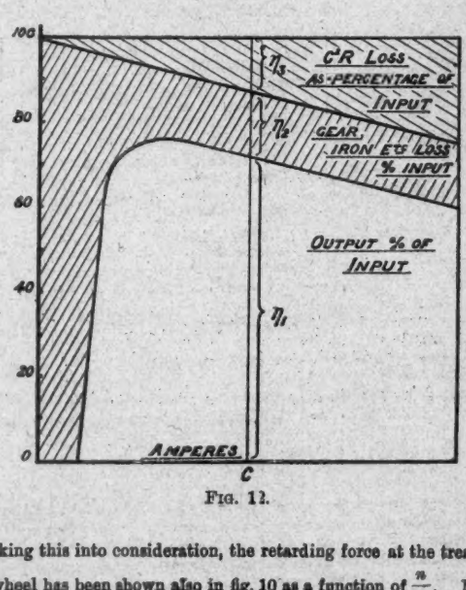

Fig. 12.

Taking this into consideration, the retarding force at the tread of the wheel has been shown also in fig. 10 as a function of $\frac{n}{R}$. Now, we may take the adhesive force of a tramcar under different conditions as follows:—

Greasy rail	...	.. 8—10	per cent. of dead weight.
Wet rail	...	... 15	" "
Dry and clean		... 20	" "
Gritty	...	... 25	" "
Sanded	...	... 30	" "

We will further take the resistance of each motor at ·96 ohm, and the external resistance on the different notches of the controller at 9·3, 7, 3·1, 1·1 and 0 ohms, respectively, *i.e.*,

Notch 1.—Total resistance in circuit		= 9·78	ohms.
" 2.	" " "	= 7·48	"
" 3.	" " "	= 3·58	"
" 4.	" " "	= 1·58	"
" 5.	" " "	= 48	"

Referring to fig. 10, we see that with a 12-ton four-wheel car, provided with one motor on each axle, travelling 19·5 miles per hour, with the controller on the first notch the retarding effort per pair of wheels will be 2,000 lbs.,—*i.e.*, the wheels will be on the point of slipping on a wet rail. Now let the retarding effort fall to 1,040 lbs., then $\frac{n}{R} = 1{\cdot}43$—*i.e.*, n = 14 miles per hour. Suppose the controller is then moved on to the second notch, retarding force =

1,800 lbs. The speed falls to, say, 8·5 miles per hour before proceeding to the third notch, and so on, thus:—

	Retarding force falls from	Speed from
Notch 1	2,000 to 1,040	19·5 to 14·0
„ 2	1,800 „ 650	14·0 „ 8·5
„ 3	2,760 „ 500	8·5 „ 3·75
„ 4	2,800 „ 800	3·75 „ 2·9

Hand brake applied.

On a good gritty rail there would probably be no slipping of the wheels, but on a wet rail there would probably be slipping for a moment when first coming on to the third and fourth notches. (Note 3.)

It will be at once recognised that the curves shown in fig. 10 are most useful in helping us to estimate the heating effect on the motors and resistance, due to coasting down long grades with the rheostatic brake on, and are further applicable in all cases where this type of brake is employed, such as for cranes, lifts, hoists, mining machinery, &c., &c.

(To be continued.)

METROPOLITAN ELECTRIC SUPPLY CO.'S ARBITRATION.

(*Continued from page 763.*)

Mr. Edward Manville, M.I.E.E., of the firm of Messrs. Kincaid, Waller, Manville & Dawson, said he had acted as consulting engineer for a large number of local authorities and companies. He was the adviser at Southampton, Shrewsbury and Dover, where the local authorities purchased the electric undertakings. He had been through the description of the plant set out in Table I. He thought the units generally were much too small for the size of the undertaking, besides being inefficient, and, of course, half of that, the electrical end, had had to be, or was to be, scrapped almost at once and replaced with good machines for generating continuous current. He thought it would be much more advisable to have scrapped the whole of the machines. It would have been a more efficient plan. A modern plant of about twice the size of these units would have an efficiency of about 26 lbs. of steam per kilowatt-hour—that was to say, very nearly half, and that was without condensing. The boilers were not bad. They had been hard worked, but were of a fairly efficient type. The feed pumps were of a wasteful character, and the general arrangements in connection with them, such as the steam pipes leading to them being unlagged, and so on, led undoubtedly to a large proportional consumption of steam in that department. Part of the switchboard, at all events in Marylebone, would, of course, be of no use when District C was changed over, and would have to be discarded. It was an old type of switchboard—a plug board.

In the result you think it is an extravagant and rather expensive method of producing electricity?—Yes; it is shown by comparison with other metropolitan stations, such, for instance, as the Westminster Company, whose cost per unit is 1·59d., and the St. James's and Pall Mall Company, whose cost per unit is 1·37d., while the Manchester Square station costs, according to the paper prepared by the accountant, 2·17d.

The Umpire: These are generating costs simply and not working expenses?—Yes.

Continuing, witness said the station at Rathbone Place was of an old type. It was still less efficient than the Manchester Square station. The units there were smaller than would be put in an exceedingly small provincial station erected to-day. The motor-generators in the Rathbone Place Station were in a most awkward and inconvenient position, and it seemed to him extraordinary that new plant such as that should have been installed under such very bad conditions. It could not fail to lead to less efficient working.

The Umpire: As regards your criticism of the plant, surely the whole practical question is whether the company in estimating the profits they would make have estimated on the footing of having such a plant or on the footing of having a more effective plant. If they have estimated only on the footing of having this plant, we do not get any help at arriving at the value of the undertaking to them by these criticisms on the plant itself.

Mr. Balfour Browne: He is only pointing out how we might have made our profits greater. We have calculated it on the defects.

Witness said the profit calculated for the future, which was the main item, was only for a very small part, as he understood, namely, that which could be earned at the two stations as they existed at present. The main portion of the profit would be that earned from the Willesden station.

The Umpire: Is not the point witness ought to take the estimated profit—not the valuation of the plant?

Witness, continuing, said he could not agree with the evidence put forward that the rubber-covered mains were in a condition practically as good as new, because of a certain test made with them. In his opinion, that test constituted no indication whatever of the condition of india-rubber-covered mains which had been in the ground for some time, and there was a great deal of general experience showing that rubber-covered mains deteriorated very rapidly—much more rapidly than the more modern systems. He had examined Table 3, which showed the past progress of the company. He thought that progress in the past had been stimulated by reductions of price, as one would expect, and if equivalent progress was to be maintained in the future, it must be by future reductions of the same sort, and he also thought that the increase in the units sold in 1898 pointed to the fact that the demands of big potential consumers, such as workshops and consumers of that sort, had previously reached their maximum, thus leaving only the actual increase which could be obtained from fresh consumers, who would be chiefly private consumers. He also thought it pointed to the fact that the company had reached a point when the least profitable section of consumers would form the majority of those connected in the future.

Asked his opinion as to the estimated figure of 24,850,000 given for lighting in 1931, witness said he had never heard a more optimistic estimate. He was used to making optimistic estimates himself, but that surpassed anything he had ever dreamed of. It represented 187 Board of Trade units per head of the population at present in Marylebone.

Mr. Balfour Browne: But this is in 1931.

Lord Robert Cecil: Then it is likely to be smaller. It is decreasing in Marylebone.

Witness said he felt distinctly that assuming there was no competition in Marylebone, if the company were allowed to go on by itself the maximum for lighting purposes by 1931 would be 12½ millions. That was a very liberal estimate, but if there was a second company in Marylebone also endeavouring to get business, then the natural commercial stimulation which would be exercised by one or the other might increase the field a little bit beyond that. That was to say, it might possibly reach 15,000,000, only in that case it would be divided between two companies. It seemed to him that Marylebone was one of the districts of London which had the least possible prospects of a substantial power supply.

At the sitting of the Arbitration on Wednesday, October 22nd, Mr. Arthur Wright continued his evidence, and was examined by Mr. A. B. Cane with regard to the estimates of the company with respect to provision for further plant. Witness expressed the opinion that if the company were right about their field, they had not made sufficient provision for further plant, and therefore their further capital expenditure would be greater than it had been admitted. In the table in 1903, the increase for lighting was put down as £673,000, and in 1904 it was £700,000, and no increase was made in those years to the kilowatts with which they started in 1902.

Mr. Cane pointed out that 500 KW. was added in each year, and that there was an increasing rate of increase, and no increase of capital. If they looked at the power columns, they would find that 100,000 units were added for 1903.

Witness said the figures were 21,000 in 1902, 100,000 in 1903, and 100,000 in 1904.

Mr. Cane: Taking the load factor for power at 20 per cent., what amount of capital would have been required to deal with that?—At £60 per 1,000 units, £6,000 in 1903, and £6,000 for power in 1904.

Witness was then examined with respect to the severance tables, and said that he understood that the item "severing mid-London portion of Rathbone Place" was due to the practice of the company supplying a good deal of mid-London from Rathbone Place. If Rathbone Place had been primarily devoted to Marylebone, the whole of the supply of Rathbone Place would have been required in Marylebone, and there would not have been any surplus supply capable of being taken by those mains to mid-London.

After considerable discussion between counsel, it was agreed that this question of severance might be left over for consideration with a view to some arrangement being come to.

Mr. Cane proceeded to examine the witness on the question of the items in the claim of the company in respect of trunk mains. Witness said he understood that one item was a claim for the loss of the trunk main between Amberley Road and mid-London, enabling mid-London—a little district in the east—to be supplied by alternating current. At the present moment he believed that Manchester Square station produced alternating current and helped Sardinia Street through its trunk main. The Sardinia Street district was chiefly continuous, excepting the small eastern portion which was still alternating. To that extent current could be sent along the main from Manchester Square to this district in the East, and he believed a capacity of 250 KW. was required for that. He believed that Manchester Square was not going to be an alternating station, and therefore it would cease to be of use for the supply of that district. When it became continuous, the trunk main could not be used for conveying continuous current from Manchester Square to Sardinia Street, because it was too small a section. If they changed the current, Manchester Square could be used for the little place in the East by a motor-generator taking continuous current, as they could do in Sardinia Street. But that was uneconomical, and it was difficult to imagine it would be necessary, because they had the alternating current from Willesden in Tower Street, which could supply all the requirements of this district by alternating current. With regard to the question of the 1,000-volt trunk mains in the Marylebone Road, witness said he assumed the company still had the right to lay trunk mains in the Marylebone Road to connect their outside station, and if that was so their claim disappeared.

Mr. Moon asked if counsel suggested that the company should lay fresh mains, or on a certain construction that they were entitled to the mains they already had.

Mr. Fletcher Moulton: You are entitled to continue them.

Mr. Moon said there was a distinction. What Mr. Cane was putting to the witness was a suggestion that the company had the right to lay joint mains. If Mr. Cane meant lay new trunk mains, the company would require to be paid for the new trunk mains they were required to lay. If, on the other hand, Mr. Cane meant continuing the mains they had at present, that was another matter.

Mr. Fletcher Moulton: That is all we mean. This claim is based on the idea that some of your existing mains will no longer be allowed to be used.

Mr. Moon: Will vest in you; that is the question, whether they do or whether they do not.

The Umpire said the matter had been stated before that if the existing connection could be maintained, then obviously the claim for the loss could not be made. What Mr. Moon called attention to was this, that it was one question to say whether the existing connection can be made, or whether the result of the Act of Parliament would not be to vest in you that existing connection. It is quite another matter to say that notwithstanding the transfer of the Marylebone area, you would be entitled, if you wished to do so, to lay trunk mains through Marylebone.

Mr. Fletcher Moulton said that was so.

The Umpire said the thing had not been argued, and he did not express any opinion. The difficulty arose from the language of that part of the Act of Parliament which dealt with what vested in the local authority, which only excludes the extra high tension mains.

Mr. Moon: Exactly. If we can retain these mains we do not want to claim compensation for their being taken away.

The Umpire: An earlier section speaks of having the right to maintain mains, if I remember rightly.

Mr. Moon: If my learned friend will consent to this, that they will re-convey to us the trunk mains which connect those stations, then it is not necessary for us to make any claim in respect to this particular item.

Mr. Fletcher Moulton said he must admit that Mr. Moon had put the matter very fairly, and he would undertake to consider it.

In reply to further questions, witness said he considered that, within two years of the starting of the Borough Council's own system, the company could be relieved from the obligation of supplying Marylebone from Willesden. Criticising the company's system generally, he thought it was somewhat a miscellaneous system, and that a great mistake had been made in not having one system for the whole of Marylebone. Had that been done, it would have reduced superintending costs and general capital costs.

Mr. Cane: And in considering that this business is to be worked on that system, do you consider that it can be described as a modern and efficient system?—No; even the most modern districts, instead of being supplied by the higher voltage that most companies use, are now supplied by a very uneconomical supply pressure of 100-volt lamps, or 200 volts on the three-wire system, instead of 480 volts that other people use on continuous current. That means having 2½ times as much capital to carry on the same business as you would have if you used modern pressure.—Adjourned.

At the sitting on October 24th, Mr. Edward Manville was recalled, and his examination was continued by Lord Robt. Cecil, K.C. Witness said he had got out the figures for Shoreditch as regarded units sold both for light and power, and he found that n the fifth year of their working—March of this year—the power units were 795,856, and the units sold for lighting 1,761,144. That was sold at an average price of 1·97d.

The Umpire: Apparently, then, these figures would show that the circumstances of Shoreditch are very different from what we should have expected from those of Marylebone?—Yes, they point to the fact that it is an industrial district.

Lord Robt. Cecil: And for the purpose of power you had to go as low as something under 2d. per unit before you could sell any considerable quantity?—Yes, 2d. and 1½d.

Continuing, Witness said he was of opinion that the demand for power in Shoreditch was much greater than it was ever likely to be in Marylebone, and as far as lighting was concerned, he should say that 12,500,000 units was the limit of the field for the company. That was taking the most optimistic view, based on the figures given as to the population and houses in Marylebone. He should say that the capital cost per 1,000 units sold for extensions would be not less that £100, and that being so, he thought that 1½ per cent. was the lowest figure that should be allowed for depreciation. He did not see how the company were going to produce current for power purposes low enough to attract custom even if there was any demand for power in Marylebone. In conjunction with Mr. Parshall, he had prepared a valuation of the existing machinery, plant and mains of the company, and he arrived at a figure of £169,198 as compared with £180,000 arrived at by Mr. Wright. The losses the company would experience in working Willesden after they had lost the Marylebone load, would consist of loss of interest on capital invested, which would not be utilised when the maximum load was lower than it was at the present time owing to the taking away of the Marylebone area. It was almost as cheap to run one engine at half load as at full load, and it was purely imaginative when the company added that element of loss.

Cross-examined by Mr. Balfour Browne: I understand your criticism to be that the running of an engine at half load does not make much difference as compared with the running of the full load?—Yes.

Will you say that a station that is capable of producing you 9,000 KW., and is only worked to produce 750 KW., is not a wasteful station?—It would be a wasteful station if you ran it as a 9,000-KW. station.

Is it not a wasteful station if its machinery is capable of producing 9,000 KW., and you only work it to give 750 KW.?—Not if the major portion is shut down so as to leave 750 in use.

Surely from a capital point of view?—Yes, I admit that. Continuing, witness said that with reference to the Shoreditch output for power, he never suggested that the Council there were supplying it at a profit; it required the reduction of the prices they made to get such an output as they had got. He had given evidence on several of the Parliamentary Committees considering the power Bills, including the Committee which considered the Caledonian Power Bill. The need of getting the load factor was that it so much improved the work that they could produce at the low rate, and with a 25 per cent. load factor in the Clyde Valley Electric Works they calculated to produce at ·664d. That, however, was not with the London coal prices or the inconveniences and inefficiences of the Metropolitan system. He would certainly recommend that the turbo-alternators in the Metropolitan Co.'s system should be scrapped, if the company wished to economise. He was afraid they could not use condensers, but they might have used larger units.

Questioned as to the price at which the company could sell their units, Witness said that every decrease in price tended to increase the consumption.

In re-examination by Mr. Fletcher Moulton, Witness said it was not safe to make calculations for distant years based on the initial years of a company.

Mr. H. F. Parshall, examined by Mr. Fletcher Moulton, K.C., said he had valued the plant of the company at great length, and had arrived at the figure of £169,000. He had seen the field of the company as estimated by the Borough Council at 12,500,000 units in 1931. In his opinion that was a very full estimate. He was accustomed to estimate what would be the probable demand for various commodities of this character. They could not, in the case of Marylebone, take it *per capita*, because the best part of Marylebone, or a considerable part of it, was in a shopping district where that would not be entirely reliable, but they could work it out from the number of tenements and deduct the class of people that they knew could not possibly come on the circuits—he meant the lower class of tenements, where several people lived in one room—and, calculating the field in that way, they would not get above 12 millions. The tables put in by the company showed that the old customer was constantly increasing and getting to be a larger and larger customer, whereas the consumption per consumer was not increasing, showing that the remaining class of customer they were taking on was not such a good customer as those they had been taking on. That experience invariably occurred in connection with electric lighting or power. He agreed with the evidence that had been given as to the extremely limited use of electricity either for heating or cooking, or, in that district, for industrial purposes. No matter what the price was in Marylebone, he did not think there would ever be any considerable field for power there. There were no industries to support any large consumption of power. Lifts were the worst class of customers they could put on their circuits. He had examined into the efficiency shown by the statistics put in by the company, and, according to the agreed tables and the figures put in, Willesden had brought down the efficiency of the system as a whole.

Just give me the figures?—1898, according to the agreed tables, 10,809,000 units were generated, 6,845,000 sold. That gave an efficiency of 63 per cent. In 1901 there were generated 19,000,000, and 11,122,000 sold. Of those, 5,000,000 were generated in the town stations, presumably at 63 per cent. Six millions of the sold units were generated at Willesden; 10,934,000 being generated, it brings the efficiency of the system from 63 per cent., as it was in 1398, to 58·6 in 1901. That low efficiency was due to the loss of transmission and motor-generators. Lower efficiency meant a larger capital outlay per 1,000 units sold, and if they had to have extra plant, which was the cause of the low efficiency, that must be added to the capital. He did not think there was any justification for the calculation of future profits on the assumption that the cost would be 40 per cent., or any fixed percentage, of the revenue. There was absolutely no relation between the cost of generation and the selling cost. Sometimes it was against them by coal strikes and various things, and it was not a correct way of examining business. They used to do it years ago, but they found that it got them into trouble.

Cross-examined by Mr. Balfour Browne, the witness said he did not think that the economical system was to have an outside station such as Willesden.

Mr. Frank Stokes, senior partner with Messrs. Richmond, Pinder and Stokes, carrying on business at 49, Upper Baker Street, and secretary of the Marylebone Association for Improving Dwellings, examined by Lord Robert Cecil, gave evidence as to the comparatively limited future field which existed in Marylebone for the supply of electricity either for power or lighting purposes.

Similar evidence was given by Mr. A. R. Rowden, of the firm of May & Rowden, estate agents and surveyors, who said that his experience was that the best premises were already to a very great extent supplied with electric light; by Mr. T. J. Bacon, electrical inspector for the Borough of Marylebone, and Mr. W. Marshall, surveyor. Adjourned.

A further sitting took place at the Westminster Palace Hotel on Saturday, November 1st, when Mr. Wm. Marshall gave further evidence regarding the value of the company's sites, &c. He valued the Manchester Square site at £2,552, and gave the capital value of the buildings on the site at £12,574. Questioned with regard to his opinion as to the future field for electric lighting in the borough, he put in figures showing the result of investigations he had made as to the houses. Taking the streets where there were the facilities in the way of mains for the company to supply, he arrived at the figure of 6,217 houses either already supplied or open to be supplied with current, and that left 7,317 houses in the borough of such a character, that, in his opinion, they were never likely to be supplied with electric current.

Mr. Balfour Browne said the figures were not accurate. The

summary he had was—houses supplied with current, 2,913; houses not supplied but open to be supplied, 3,306.

By the Umpire: The figures came from the streets where the company was already supplying.

Witness, continuing, said he formed his opinion as to the houses likely to be supplied by inspection. He thought he could tell pretty well whether a house would be supplied with electricity eventually. If he saw a house he could form an opinion as to whether they were likely to take current or not. He took it generally that a house under £60 a year rental was not likely to take electric current. He assumed that all the customers the company were likely to get in the borough, they would get within the next seven years, and he gave the following estimate of increases in units supplied:—In 1904, 500,000 units; in 1905, 420,000, units; in 1906, 304,000 units; in 1907, 260,000 units, and in 1908, 180,000 units, making a total in the seven years of 2,940,000 units. He thought the installations would be about completed then, except, of course, in the case of new buildings built to take the place of old ones, and flats. He did not think they would build many more flats in the future, because they were rather a drug in the market now. Still he thought that 100,000 units per annum would suffice for future increase.

Taking the increase at that rate, your estimate for the total sales in 1931 is what?—9,778,457 units.

Mr. Arthur Ashbridge, Fellow Royal Institute of British Architects, the deputy surveyor of Marylebone, expressed the opinion that the people who were requiring electric light in the southern half of the district had already got it to a very great extent. He did not think it would be adopted in medium-sized houses much, and not at all in dwellings for the working classes. He defined a medium-sized house as one of about £60 a year. His impression was that they had sufficient flats in Marylebone, and the difficulty of letting them seemed to prove it. He did not think it at all likely that there would be more rebuilding in the borough than they had been having. He knew that Messrs. Waring were erecting premises which would occupy the site of 36 houses, and he had reason to believe that they would have their own installation. Many of the large business places in Marylebone had their own installations. There had been a great increase of buildings for the working classes erected, but electric light would not be required for them. He believed that in the Lisson Grove district many houses for the working classes could be built.

In cross-examination, Witness said he believed that one firm with its own installation took part of its electricity from the company. He had not heard that another had asked the company to put up their electricity as a stand-by and had been refused. He did not know that the Army and Navy Stores had a plant but were not using it, but were taking electricity from the St. James's Co.

Mr. Alfred Gordon Salamon, analytical and consulting chemist; vice-President of the Institute of Chemistry; and past-President of the Society of Chemical Industry, stated that he had given a great deal of attention to the manufacture of gas. In Marylebone for the year 1889 the consumption of gas for street lamps was 61,000,000, and for private consumers 1,141,000,000, a total of 1,202,000,000 cub. ft. The use of the incandescent mantle for the enrichment of the illuminating power of gas had completely revolutionised gas as an illuminating agent. The introduction of that invention was dated about 1883, and the result of this and other inventions and improvements was that gas could be obtained very much more cheaply than was once the case. Examined on the comparative cost of electricity and gas, Witness said:—"Taking gas at 14 candles at 5 cub. ft. per hour—that is standard gas at 14 candles—that gives me 2,800 candle-hours per 1,000 cub. ft. of gas, and on the assumption that that is 2s. 6d. per 1,000, that is the number of candle-hours that I get for 2s. 6d. Now reckoning the mantle to give six times the efficiency, which it is proved to do, that 1,000 ft. of gas would give me 16,800 candle-hours for 2s. 6d. Now, I take one unit of electricity as equal to 250 candle-hours—I think that is admitted—therefore 16,800 candle-hours are equal to 67 units. I think you will find that is what it works out at, and if I take that at 5d. per unit, that costs 26s. 3d. as against 2s. 6d." Continuing, Witness said he had had a great deal of experience on the Continent, and believed that the incandescent gas is the preferred light. He thought the invention of the mantle had stemmed the tide of competition of the electric light.

Witness was asked by Mr. Sarjent how he accounted for the fact that there was an increase in the company's business of 800,000 units to 4,617,000 units in 1901, and in reply said he did not know how to account for it. He did not know whether the incandescent mantle was in full competition during the period, but unquestionably it was to-day.—Adjourned.

NEW PATENTS, 1902.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

22,760. "Improvements in tramway and railway rails, and in means of bonding such rails for the purpose of electrical connection." H. M. Brewood and H. M. Brewood. October 20th.

22,774. "Improvement in apparatus for controlling the supply of electricity by a combined lock switch and plug applicable as a lock switch." E. Liddle and H. C. Watson. October 20th.

22,817. "Improvements in trolley heads for electric railways and tramways on the overhead system." C. S. Schultz. October 20th.

22,825. "Improvements in automatic switches for single-phase and poly-phase transformers." A. Schlatter. October 20th. (Complete.)

22,827. "Improvements relating to incandescent electric lamps." La Société Anonyme la Lampe "Hollub." (Date applied for under Patents Act, 1901, November 30th, 1901, being date of application in France.) October 20th. (Complete.)

22,829. "Improvements in electro-pneumatic controlling systems for railway vehicles." F. W. Le Tall. (G. Westinghouse.) October 20th.

22,841. "Improvements in or relating to speed-indicators, applicable to electric tramcars and other vehicles, and to shafts and other rotating bodies." A. H. Walton. October 20th.

22,853. "Improvements in the manufacture or production of stop-butt hinges for silver and electro-plate ware and for other purposes." H. W. Taylor. October 21st.

22,854. "Improvements in electric fuses." W. B. Daly. October 21st. (Complete.)

22,956. "Improved construction of incandescent electric lampholders. E. Schulz. October 21st.

22,957. "Improved construction of electric switch." E. Schulz. October 21st.

22,964. "Improvements in switches for tramways." H. Manke and F. W. Engels. October 21st.

23,011. "Improvements in and relating to telephone receivers." A. Mabe. October 22nd.

23,021. "Improvements in or connected with apparatus for electrically igniting miners' safety lamps." R. O. Best and Ackroyd & Best, Ltd. October 22nd.

23,023. "Improvements in or connected with apparatus for electrically igniting miners' safety lamps." R. O. Best and Ackroyd & Best, Ltd. October 22nd.

23,045. "Improvements in electrical arc light." F. J. Gerard. October 22nd.

23,047. "Improvements in the manufacture of tubular metallic telegraph and like poles and in machinery to be used in the said manufacture." F. C. Guy. October 22nd.

23,048. "A winding device for cables to which movable electric apparatus is attached." G. Ackermann and G. Engisch. October 22nd. (Complete.)

23,065. "Improvements in systems of electric lighting." H. Leitner and R. N. Lucas. October 23rd.

23,114. "Improvements in and relating to storage and other batteries." J. T. Niblett. October 23rd.

23,115. "Improvements in or relating to current or charge meters or indicators for use chiefly in connection with storage batteries." J. T. Niblett. October 23rd.

23,116. "Improvements in or relating to current regulators for use in connection with the charging of storage batteries and for other purposes." J. T. Niblett. October 23rd.

23,134. "Improvements in and relating to the taking of the readings of gas and electricity meters and to similar purposes." G. G. Bell. October 23rd.

23,151. "Battery installation for submarine boats." S. Lake. October 23rd.

23,191. "Improvements in and connected with clips for electrical fuses." A. Handley, D. Shanks and J. E. Hayes. October 24th.

23,230. "Improvements relating to electrical connections or couplings." F. Keukl. October 24th.

23,231. "Improvements in signal devices for telephone systems." E. P. Baird. October 24th.

23,243. "Improved insulating material for electrical purposes and processes for manufacturing the same." H. Sefton-Jones, of the firm of W. P. Thompson & Co. (Isolé Werke Actien Gesellschaft, Switzerland.) October 24th.

23,255. "Improvements in apparatus for use in electric telegraphy or the like." C. M. Jacobs and A. H. Nicholson. October 24th.

23,257. "An improvement in flexible metallic tubing for armouring insulated electrical conductors." W. H. K. Bowley. October 24th.

23,262. "Improvements in or relating to the manufacture of carbons for arc lamps and the like." A. Blondel. October 24th.

23,278. "Improvements in electric conduits or insulators." R. Illemann. October 24th.

23,279. "Improvements in and relating to the prevention of sparking on the interruption or variation of powerful electric currents." K. Birkeland. (Date applied for under Patents Act. 1901, October 24th, 1901, being date of application in Norway.) October 24th. (Complete.)

23,288. "Improvements in and relating to alternating current dynamo-electric apparatus." G. Winter and F. Eichberg. October 24th.

PUBLISHED SPECIFICATIONS, 1900.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

16,293. "Improvements in electric furnaces." J. Imray. (Communicated.) Dated September 13th, 1900. 2 claims.

16,299. "Improved construction of electric switch." E. Schulz. Dated September 13th, 1900. 2 claims.

16,308. "Improvements in switchboards applicable for electric call apparatus." C. Shore and C. Heap. Dated September 13th, 1900. 2 claims.

16,329. "Improvements in or connected with electrical switches." S. S. Berry. Dated September 14th, 1900. 3 claims.

16,369. "Improved apparatus for trimming commutators." J. Phillips. Dated September 14th, 1900. 2 claims.

16,408. "Improvements in the electrodes of electro-chemical accumulators." J. Von der Poppenburg. Dated September 14th, 1900.

16,415. "Improved means for supporting electric lamps." W. G. Inglefield. Dated September 15th, 1900. 2 claims.

16,488. "Improvements in portable electric batteries." M. E. Fuld. Dated September 15th, 1900. 4 claims.

16,500. "An improved high voltage electric cut-out." A. Eckstein and A. J. D. Krause. Dated September 17th, 1900. 2 claims.

16,501. "Improvements in arc lamp suspension apparatus, applicable also to other purposes." A. Eckstein and A. E. Angold. Dated September 17th, 1900. 2 claims.

16,541. "Improvements in electric switching and metering apparatus." J. G. Lorrain. Dated September 17th, 1900. 11 claims.

16,544. "Improvements in electricity meters." S. Z. de Ferranti. Dated September 18th, 1900. 3 claims.

16,607. "Improvements in systems of electrical distribution." British Thomson-Houston Co. Dated September 19th, 1900. 6 claims.

16,608. "Improvements in conduit ploughs for electric railways." British Thomson-Houston Co. Dated September 19th, 1900. 4 claims.

16,700. "Improvements in systems of electrical distribution." British Thomson-Houston Co. Dated September 19th, 1900. 5 claims.

16,701. "Improvements relating to electrically-operated pumps." British Thomson-Houston Co. Dated September 19th, 1900. 8 claims.

16,703. "Improvements in dynamo-electric machines." British Thomson-Houston Co. Dated September 19th, 1900. 8 claims.

16,703. "Improvements in controlling electric motors." British Thomson-Houston Co. Dated September 19th, 1900. 8 claims.

16,704. "Improvements for adjusting brush-holders for electric machines." British Thomson-Houston Co. Dated September 19th, 1900. 10 claims.

16,705. "Improvements relating to electro-magnetic switches used for electric train control." British Thomson-Houston Co. Dated September 19th, 1900. 8 claims.

16,706. "Improvements in means for preventing hunting of dynamo-electric machines." British Thomson-Houston Co. Dated September 19th, 1900. 6 claims.

16,798. "Improvements in underground conductors for electric conductors." J. Zappe. Dated September 20th, 1900. 4 claims.

16,801. "Process and apparatus for the electrolytic decomposition of alkaline salt solutions." A. J. de Cunha. Dated September 20th, 1900. 7 claims.

16,865. "Improvements in and relating to devices for carrying electric cables, wires, and the like." D. P. Regan. Dated September 22nd, 1900. 1 claim.

16,916. "Improvements in or connected with electro-magnets." J. Wetter. Dated September 22nd, 1900. 2 claims.

16,966. "Improved electro-motor." A. E. Fauer. Dated September 24th, 1900. 3 claims.

17,027. "Improvements in method of, and apparatus for, treating ores." G. M. Westman. Dated September 25th, 1900. 13 claims.

17,049. "Improvements in coin-operated electric meters." F. Kraemer and E. Weber. Dated September 25th, 1900. 18 claims.

17,110. "An arrangement of connections for sets of electric glow lamps in series so as to maintain the circuit in case of the extinction of one or more of the lamps." Siemens Bros. & Co. Dated September 26th, 1900.

17,194. "Improvements in electric switches." J. M. Hewitt and W. G. Rhodes. Dated September 27th, 1900.

17,234. "Improved means for generating variable electromotive force." J. E. Miller. Dated September 28th, 1900.

17,243. "An improved process for rendering silver surfaces untarnishable." L. Sterne and Cowper-Coles. Dated September 28th, 1900.

17,250. "Improvements in life-guards for tramcars." W. T. Watson. Dated September 28th, 1900.

17,290. "Improvements relating to automatic electric switches." A. H. Adams. Dated September 29th, 1900.

17,293. "Improved thermo-regulator, or thermostat." R. Kann. Dated September 29th, 1900.

17,373. "Improvements relating to electric meters." H. H. Lake. Dated October 1st, 1900.

17,436. "Improvements in combined relays and repeaters." E. C. Paramore. Dated October 2nd, 1900.

17,437. "Improvements in telegraphones." E. C. Paramore. Dated October 2nd, 1900.

17,467. "Improvements relating to telephone switchboards." H. T. Cedergren and O. Kahr. Dated October 2nd, 1900.

17,485. "Process for making copper sulphates and other metallic sulphates." H. J. U. Palas and F. A. J. Cotta. Dated October 2nd, 1900.

17,490. "Improvements in the manufacture of secondary battery plates." B. Kuettner. Dated October 2nd, 1900.

17,496. "Improvements in and relating to ceiling roses and terminals for electrical lamps and power installations." H. Hirst and H. Bevis. Dated October 2nd, 1900.

17,507. "Improvements relating to electric lanterns to be fixed on the top of posts." H. F. Proctor. Dated October 3rd, 1900.

17,514. "Improvements in electric switches." E. W. Cowan and W. P. Hamlyn. Dated October 3rd, 1900.

17,583. "Improvements in or relating to wheels and hubs containing their own motors." J. Ledwinka. (Communicated.) Dated October 3rd, 1900.

17,589. "Improvements in electrically operating signal bells and apparatus for that purpose." P. M. Jerrard. Dated October 3rd, 1900.

17,642. "A new or improved instrument for measuring direct or alternating electric currents and potential differences." W. du B. Duddell. Dated October 4th, 1900.

17,650. "New or improved means for indicating the presence of a train or trains in railway stations." F. Butterworth and G. Bennett. Dated October 5th, 1900.

17,670. "A new or improved method of combining a telephone with a system of electric bells." H. Alexander and A. D. Hunter. Dated October 5th, 1900.

17,675. "Improvements in systems of electrical distribution." C. I. Young. Dated October 5th, 1900. (Date applied for under Sec. 103 of Patents, &c., Act, 1883, March 6th.)

17,688. "Improvements in railway rail joints, applicable also to the switches." P. Krause. Dated October 5th, 1900.

17,694. "Improvements in or relating to the attachment of arc lamps to their weather-hoods or supports." C. Oliver. Dated October 5th, 1900.

17,722. "Improvements in or in connection with electric light fittings." C. M. Stead. Dated October 6th, 1900.

17,724. "Improvements in dynamo-electric generators." C. T. Batchelor. Dated October 6th, 1900.

17,727. "Improvements in and relating to electrode plates." W. P. Thompson. Dated October 6th, 1900.

17,765. "An improvement in connecting the glow bodies of incandescent electric lamps to the leading-in wires." P. Scharf. Dated October 6th, 1900.

17,839. "An improved device for measuring upward pressures, and particularly for enabling the trolley arms of electric tramcars and vehicles being set to exert a certain upward pressure on the wire." J. Wilkinson. Dated October 8th, 1900.

17,846. "Improvements in telephonic apparatus." C. Shore and C. Heap. Dated October 8th, 1900.

17,904. "Improvements in or relating to electric meters." J. Ellis. Dated October 9th, 1900.

18,000. "Improvements connected with overhead trolley poles used in electric traction." W. E. Rowlands. Dated October 10th, 1900.

18,001. "Improvements in or applicable to switches for electric motors." J. P. Hall. Dated October 10th, 1900.

18,003. "Improvements in conduits for electric conductors." H. Tugby. Dated October 10th, 1900.

18,031. "Improvements in telephone systems." M. G. Kellogg. Dated October 10th, 1900.

18,036. "Improvements in, or relating to, thermo-electric generators." A. J. Boult. Dated October 10th, 1900.

18,045. "Improvements in distributing heads or terminal boxes for electric cables." G. E. Heyl-Dia. Dated October 10th, 1900.

18,056. "Improved conduit for electric cables." E. L. Kiss. Dated October 10th, 1900.

18,059. "Improvements in electric railways and tramways on the closed conduit system." G. B. Marzi. Dated October 10th, 1900.

18,114. "Improvements in polyphase alternating-current transformers." C. Schaller. Dated October 11th, 1900.

18,130. "Improvements in the automatic regulation of railways and the like, where the trains follow or meet one another." R. C. Sayer. Dated October 12th, 1900.

18,184. "Improvements in shades of electric incandescence lamps." Spiral Globe, Ltd., & Livet. Dated October 12th, 1900.

18,212. "Method for the treatment of disease and apparatus therefor." J. Burry. Dated October 13th, 1900.

18,281. "Improvements in the control of electric motors, and similar devices from several different points, and in the means therefor." H. W. Leonard. Dated October 13th, 1900.

18,282. "Improvements in the junction boxes for electric cables and in forming branch connections therefrom." J. A. Jeckell. Dated October 13th, 1900.

18,288. "Improvements in junction boxes suitable for connecting high-tension conductors." J. Hetherington. Dated October 13th, 1900.

18,296. "Improvements in electric couplings." C. B. Walker. Dated October 15th, 1900.

18,347. "Switch apparatus for electrically-propelled vehicles." V. I. Feeny. (Allgemeine Elektricitäts-Gesellschaft.) Dated October 15th, 1900.

18,357. "Improvements in and in apparatus for taping insulated conductors." G. E. Heyl-Dia. Dated October 15th, 1900.

18,397. "Improvements in the electrolytic decomposition of alkaline chlorides, and in the apparatus employed therefor." J. D. Gilmour. Dated October 16th, 1900.

18,431. "Improvements in or connected with travelling ovens." C. M. Byham. Dated October 16th, 1900.

18,434. "Improvements in or relating to the feeding mechanism of arc lamps." C. Oliver. Dated October 16th, 1900.

18,451. "Circuit controller for electric street railway cars and other uses." W. A. McCallum. Dated October 16th, 1900.

18,613. "Improvements in rectifiers for periodic electric currents." British Thomson-Houston Co. Dated October 18th, 1900.

18,614. "Improvements in end play devices for rotary electrical machines." British Thomson-Houston Co. (Communicated.) Dated October 18th, 1900.

18,615. "Improvements in electro-magnetic blow-outs for electric cut-outs." British Thomson-Houston Co. (Communicated.) Dated October 18th, 1900.

18,616. "Improvements in electric controllers." British Thomson-Houston Co. (Communicated.) Dated October 18th, 1900.

18,617. "Improvements in high-potential electric-circuit breakers." British Thomson-Houston Co. (Communicated.) Dated October 18th, 1900.

18,618. "Improvements in electrical indicating and measuring instruments." British Thomson-Houston Co. (Communicated.) Dated October 18th, 1900.

18,645. "Improvements in electric furnaces." A. Parker. Dated October 18th, 1900.

18,656. "Improvements in commutator brush holders." H. Bishop. Dated October 18th, 1900.

18,658. "A new or improved system of and apparatus selective electric signalling and operating mechanism at a distance." P. de Chimkevitch. Dated October 8th, 1900.

18,713. "Improvements in switches or points for suspension railways." W. P. Thompson. (Communicated.) Dated October 8th, 1900.

18,767. "Improvements in safety devices for the trolley poles of electric cars." C. R. Bellamy, W. J. Turner and D. R. W. Hardman. Dated October 20th, 1900.

18,789. "Improvements in and relating to electricity meters." F. L. Catenhusen. Dated October 20th, 1900.

18,790. "Improvements in and relating to brakes or regulators for measuring instruments." F. L. Catenhausen. Dated October 20th, 1900.

18,793. "Improvements in or relating to electric railways operated on the conduit system." W. Chapman. Dated October 20th, 1900.

18,794. "Improvements in insulators." W. Chapman. Dated October 20th, 1900.

18,816. "Apparatus for indicating phase and frequency relations in electric alternating current systems." C. L. Clarke. Dated October 22nd, 1900.

18,820. "Improvements in electric arc lamps." H. Bremer. Dated October 22nd, 1900.

18,855. "Improvements in connection with electrically driving machine tools, or other mechanism." T. Humpage. Dated October 22nd, 1900.

18,865. "Improvements in apparatus for the production of electrical oscillations." J. A. Fleming and Marconi's Wireless Telegraph Co. Dated October 22nd, 1900.

18,904. "Improvements in or relating to thermo-electric batteries." W. J. Crawford and T. B. Turley. Dated October 23rd, 1900.

18,914. "Electric meters." T. A. Edison. Dated October 23rd, 1900.

18,921. "Improvements relating to electric furnaces." G. Benedicks. Dated October 23rd, 1900.

18,924. "Improvements in electric switches." W. H. Chipperfield. Dated October 23rd, 1900.

18,967. "Improvements in electric incandescent lamps." R. B. Ransford. (A. W. Wallace.) Dated October 23rd, 1900.

19,026. "Obtaining chromic acid." C. Schneider. Dated October 24th, 1900.

19,058. "Improvements in and connected with electric brake circuits and controllers for electric railway." F. C. Newell. Dated October 24th, 1900.

19,071. "Improvements in and relating to an electric generator with governing arrangements for ignition purposes on motor-car engines or stationary gas and oil engines and other purposes." F. T. Reid. Dated October 25th, 1900.

19,072. "Improvements in electric accumulators." G. B. Gibbs. Dated October 25th, 1900.

19,099. "Improved electrodes for accumulators of electricity." J. Myres. Dated October 25th, 1900.

19,151. "Improvements in trolley heads for overhead electric railways." R. J. Urquhart and H. Goodwin. Dated October 26th, 1900.

19,186. "Improvements in and connected with electrical pushes and switches." E. G. Harcourt. Dated October 26th, 1900.

19,213. "Improvements in dynamo-electric machines and motors and in means for regulating the same." L. B. Atkinson. October 6th, 1900.

19,220. "Improvements in unions or connections for electric light pendants and other fittings." Hirst and Collings. October 26th.

19,263. "Improvements in rheostats." L. Kamm. Dated October 27th, 1900.

19,280. "Improvements in electric arc lamps." Jandus Arc Lamp and Electric Co. Dated October 27th, 1900.

19,291. "An improved process and means for the reproduction by electro-depositing of high relief and undercut designs." G. Rosilier and Dellagnana and Co. Dated October 2 th, 1900.

19,571. "Improvements in switches for starting and stopping electric motors." E. Norris. Dated October 30th, 1900.

19,3-3. "Improvements in and connected with electric arc lamps" F. R. Boardman. Dated October 30th, 1900.

19,336. "Improvements in electric time switches." C. H. Offord and S. Jevons. Dated October 30th, 1900.

19,393. "Improvements in apparatus for electrically treating air gases and gaseous mixtures." R. J. Yarnold. Dated October 30th, 1900.

19,394. "Improvements in lampholder switches for electric lighting." G. H. Chard. Dated October 30th, 1900.

19,411. "Improvements in and relating to apparatus for transmitting signals." J. W. Stover. Dated October 30th, 1900.

19,416. "Improvements relating to telephone call recorders." H. D. Stroud. Dated October 30th, 1900.

19,425. "Improvements in and relating to electric coherers." E. Ducretet. Dated October 30th, 1900.

19,433. "Improvements in electric arc lamps." C. Schuster. Dated October 30th, 1900.

19,451. "Improvements in and relating to electrical condensers." G. F. Mansbridge. Dated October 30th, 1900.

19,951. "Improvements relating to arc lamps." G. E. Heyl-Dia. November 6th, 1900.